

Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Soil/Sediment/Surface Water Remedial Investigation of Quarry Area

Former Naval Air Station Brunswick Brunswick, Maine



BRAC PMO East

Contract Number N62472-03-D-0057 Contract Task Order 69

September 2014

Date: September 2014 Worksheet 1 Page 1 of 178

SAP Worksheet #1 -- Title and Approval Page

(UFP-QAPP Manual Section 2.1)

SAMPLING AND ANALYSIS PLAN (Field Sampling Plan and Quality Assurance Project Plan) September 2014

SOIL/SEDIMENT/SURFACE WATER REMEDIAL INVESTIGATION OF QUARRY AREA FORMER NAVAL AIR STATION BRUNSWICK, MAINE

Prepared for:

BRAC PMO East 4911 South Broad Street Philadelphia, PA 19112-1303

Prepared by:

Tetra Tech NUS 661 Andersen Drive Pittsburgh, Pennsylvania 15220-2745 412-921-7090

Prepared under:

Comprehensive Long-Term Environmental Action Navy
Contract No. N62472-03-D-0057
Contract Task Order 69

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Quality Assurance Officer/Chemist

NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Date: Junely 2014 Worksheet 1 Page 1 of 170

SAP Worksheet #1 -- Title and Approval Page

(UFP-QAPP Manual Section 2.1)

DRAFT

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Remedial Project Manager

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Quality Assurance Officer/Chemist

031303/P

CTO 69

Revision: 1

Date: September 2014 Worksheet 1

Page 2 of 178

EXECUTIVE SUMMARY

Tetra Tech, Inc., NUS operating unit, (Tetra Tech NUS) has prepared this Uniform Federal Policy (UFP)

Sampling and Analysis Plan (SAP) that encompasses Field Sampling Plan (FSP) and Quality Assurance

Project Plan (QAPP) requirements for the Soil/Sediment/Surface Water Remedial Investigation (RI) of the

Quarry Area at the former Naval Air Station (NAS) Brunswick, Maine, under Contract Task Order (CTO)

69, Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62472-03-D-0057.

Groundwater was investigated independently from soil, sediment, and surface water.

This SAP was generated for and complies with applicable United States Department of the Navy, United

States Environmental Protection Agency (USEPA) Region I, and Maine Department of Environmental

Protection (MEDEP) requirements, regulations, guidance, and technical standards. This includes the

Department of Defense (DoD), Department of Energy (DOE), and USEPA Intergovernmental Data Quality

Task Force (IDQTF) environmental requirements regarding federal facilities. This SAP is presented in the

format of standard worksheets specified in the UFP Quality Assurance Project Plans (UFP-QAPP)

guidance documents (IDQTF, 2005).

SCOPE AND OBJECTIVES

This SAP outlines the organization, project management, objectives, planned activities, measurement,

data acquisition, assessment, oversight, and data review procedures associated with the planned soil,

sediment, surface water, and associated lithology investigations at the Quarry Area. Protocols for sample

collection, handling, storage, chain of custody, laboratory and field analyses, data validation, and

reporting are also addressed in this SAP.

The overall objective of this in this project is to investigate and address the following three different types

of potential contaminants:

Munitions and explosives of concern (MEC)

Soil, sediment, surface water, and groundwater contamination from munitions constituents (MC) and

other Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)-listed

contaminants

Radiological contaminants (RAD)

USA Environmental, Inc. (USA) is the contractor responsible for the MEC RI, general coordination of the

three studies listed above and completion of a comprehensive Feasibility Study (FS). They have

Revision: 1

Date: September 2014

Worksheet 1 Page 3 of 178

developed a plan to investigate munitions via a sampling and analysis plan (SAP) for their scope of work.

Tetra Tech NUS is responsible for continuation of the soil, sediment, and surface water contamination

investigation. Groundwater data was collected during previous investigations as discussed below. Tetra

Tech EC is the contractor responsible for the RAD investigation; they have developed specific work plans

for their field work at the Quarry Area. Parsons Government Services, Inc. (Parsons) is subcontracted by

USA to evaluate the risk assessments and prepare the comprehensive FS.

The primary objective of this Quarry Area Soil/Sediment/Surface Water RI is to provide sufficient data to

identify any areas that are contaminated with MC and/or non-munitions-related contaminants. Pending

the results of the MEC investigation, those areas that are identified as non-contaminated with respect to

MEC, MC, or other wastes may be removed from the Quarry Area site boundary. A second sampling

objective is to calculate ecological and human health risk to aid in decision making.

Prior to development of this document a decision was made by the Stakeholders to prepare an

abbreviated work plan concurrent with similar investigations at Site 12, related to investigation of

groundwater, in an effort to keep moving the project forward. Conditional approval was granted by

USEPA and Maine Department of Environmental Protection (MEDEP) in July 2012 to conduct field work

on the groundwater portion of the RI scope. For the groundwater investigation, a desktop bedrock

fracture survey was completed in July 2012, and three staff gauges and four monitoring wells were

installed in August 2012 in accordance with the approved Site 12 Work Plan dated May 2012 and Quarry

Area Groundwater Work Plan (Tetra Tech, 2012c). Based on the results of groundwater elevation

contouring and evaluation of groundwater results, an additional nine monitoring wells were installed in

2013 to improve understanding of shallow groundwater flow directions, confirm the 2012 groundwater

analytical results, and further characterize groundwater conditions at the Quarry. The 2013 follow-on

investigation was conducted in accordance with Tetra Tech's Quarry Area Groundwater Work Plan Tech

Memo Addendum dated October 2013, and field work was performed in November through December

2013. The associated report is under review; however, lithology information obtained from soil borings

associated with monitoring well installation during the investigation is used as necessary herein.

INVESTIGATIVE AREA

The Quarry Area site history is complex based on multiple historical operations including quarrying, waste

disposal, landfarming, munitions disposal and suspected munitions detonation. Moreover, the

groundwater investigation indicates a varied site lithology. This SAP governs the collection of soil,

sediment, and surface water samples to evaluate the extent of chemical contamination and to evaluate

risks to human and ecological receptors from potential exposure to contaminated environmental media

Revision: 1

Date: September 2014 Worksheet 1

Page 4 of 178

and the collection of lithological information. To facilitate an effective evaluation of chemical contamination and because of the mixed history of Quarry Area, the site was divided into the following decision units (DUs) based on site operations and various media of interest, included in parentheses;

- DU1, Quarried Backfill Area north of Radar Tower Access Road (soil)
- DU2, Quarried Backfill Area Inside Quarry Fence (soil)
- DU3, Landfarming Area (soil)
- DU4a, Detonation Area (soil)
- DU4b, Kickout Area (soil)
- DU5, Seasonal Drainage Areas (sediment and surface water)
- DU6, Groundwater, which was addressed in a separate previous investigation

The areas inside the Quarry fence (DU2, DU3, and DU4a) are of most concern from a chemical contamination perspective because that is where waste disposal occurred. Lateral and vertical boundaries for DU1 through DU5 are not yet established. Although some DUs overlap laterally, these overlapping DUs can be differentiated vertically based on the current-day CSM. Specifically, DU3, Landfarming Area, and DU4b, Kickout Area, are vertically situated above DU2, Quarried Backfill Area Inside Quarry Fence.

The RI data will be used to update the CSM and to render project decisions regarding the adequacy with which contamination has been delineated and whether risks are unacceptable.

SAP Worksheets

SAP Worksheet #1 Title and Approval Page	1
SAP Worksheet #2 SAP Identifying Information	
SAP Worksheet #3 Distribution List	16
SAP Worksheet #4 Project Personnel Sign-Off Sheet	19
SAP Worksheet #5 Project Organizational Chart	21
SAP Worksheet #5, Figure 5-1 Project Organizational Chart	
SAP Worksheet #6 Communication Pathways	
SAP Worksheet #7 Personnel Responsibilities and Qualifications Table	28
SAP Worksheet #8 Special Personnel Training Requirements Table	31
SAP Worksheet #9 Project Scoping Session Participants Sheet	32
SAP Worksheet #10 Site History and Background	33
SAP Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements	41
SAP Worksheet #12 Measurement Performance Criteria Table - Field Quality Control Samples	53
SAP Worksheet #13 Secondary Data Criteria and Limitations Table	54
SAP Worksheet #14 Summary of Project Tasks	
SAP Worksheet #15a Reference Limits and Evaluation Table - Soil	
SAP Worksheet #15b Reference Limits and Evaluation Table - Sediment	73
SAP Worksheet #15c Reference Limits and Evaluation Table – Surface Water	80
SAP Worksheet #16 Project Schedule/Timeline Table	
SAP Worksheet #17 Sampling Design and Rationale	
SAP Worksheet #18 Sampling Locations and Methods/SOP Requirements Table	
SAP Worksheet #19 Analytical SOP Requirements Table	
SAP Worksheet #20 Field Quality Control Sample Summary Table	
SAP Worksheet #21 Project Sampling SOP References Table	
SAP Worksheet #22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table	118
SAP Worksheet #23 Analytical SOP Reference Table	
SAP Worksheet #24 Analytical Instrument Calibration Table	124
SAP Worksheet #25 Analytical Instrument and Equipment Maintenance, Testing, and Inspection	
Table	
SAP Worksheet #26 Sample Handling System	
SAP Worksheet #27 – Sample Custody Requirements Table	
SAP Worksheet #28 Laboratory QC Samples Table	
SAP Worksheet #29 Project Documents and Records Table	
SAP Worksheet #30 Analytical Services Table	
SAP Worksheet #31 Planned Project Assessments Table	
SAP Worksheet #32 Assessment Findings and Corrective Action Responses	
SAP Worksheet #33 QA Management Reports Table	
SAP Worksheet #34 Verification (Step I) Process Table	
SAP Worksheet #35 Validation (Steps IIa and IIb) Process Table	
SAP Worksheet #36 Analytical Data Validation (Steps IIa and IIb) Summary Table	
SAP Worksheet #37 Usability Assessment	
REFERENCES	174

CTO 69 031303/P

Date: September 2014 Worksheet 1 Page 6 of 178

LIST OF TABLES

17-1 Soil/Sediment/Surface Water Sampling Strategy

LIST OF FIGURES

- 10-1 Facility and Quarry Area Site Locations
- 10-2 Conceptual Site Model
- 11-1 Quarry Area Site Layout and Decision Unit Locations
- 17-1 Scope of RI MEC Transects
- 17-2 Waste Disposal Area Scope of RI MEC and Soil/Sediment/Surface Water/Lithology Sampling
- 17-3A Sample Collection and Path Forward Decision Tree for DU1
- 17-3B Sample Collection and Path Forward Decision Tree for DU2, DU3, and DU4a
- 17-3C Sample Collection and Path Forward Decision Tree for DU4b
- 17-3D Sample Collection and Path Forward Decision Tree for DU5

LIST OF APPENDICES

- A MEC SAP Figures (USA Environmental)
- B Project Screening-Level Support Documentation
- C Technical Memorandum Groundwater Report
- D Human Health Risk Assessment Methodology
- E Ecological Risk Assessment Methodology
- F Bedrock Fracture Trace Analysis Report
- G Site-Specific Field Standard Operating Procedures
- H Laboratory DoD ELAP Certification/Maine Certification
- I Response to Regulatory Comments

Revision: 1 Date: September 2014 Worksheet 1

Worksheet 1 Page 7 of 178

ACRONYMS AND ABBREVIATIONS

amu atomic mass unit

APP Accident Protection Plan

BACSE Brunswick Area Citizens for a Safe Environment

BFB Bromofluorobenzene
bgs Below ground surface

BRAC Base Realignment and Closure

°C Degree Celsius
CA Corrective action

CAS Chemical Abstract Service
CCC Calibration Check Compound

CCME Canadian Council and Ministers of the Environment

CCV Continuing Calibration Verification

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act

CFR Code of Federal Regulations

CG Certified Geologist

CLEAN Comprehensive Long-Term Environmental Action Navy

CLP Contract Laboratory Program
COPC Chemical of potential concern

CSM Conceptual site model
CTO Contract Task Order

CVAA Cold Vapor Atomic Absorption
%D Percent drift or percent difference

DDESB Department of Defense Explosives Safety Board

DFTPP Decafluorotriphenylphosphine
DGM Digital geophysical mapping

DL Detection limit

DOD Department of Defense
DOE Department of Energy
DOP Dilution of Precision

DOT Department of Transportation

DPT Direct-push technology
DQI Data Quality Indicator
DQO Data Quality Objective

DU Decision Unit

Revision: 1 Date: September 2014

Worksheet 1 Page 8 of 178

DVM Data Validation Manager ECD Electron Capture Detector

Eco SSL Ecological Soil Screening Level

EDD Electronic data deliverable

ELAP Environmental Laboratory Approval Program

EOD Explosive ordnance disposal

EPH Extractable petroleum hydrocarbons

ERA Ecological Risk Assessment
ESL Ecological Screening Level
ESV Ecological screening value

EU Exposure Unit

°F Degree Fahrenheit

FID Flame ionization detector
FOL Field Operations Leader

FS Feasibility Study
FSP Field Sampling Plan

FTMR Field Task Modification Request

g Gram

GC Gas Chromatography
GPS Global positioning system
HASP Health and Safety Plan

HAZWOPER Hazardous Waste Operations and Emergency Response

HCI Hydrochloric acid

HDEP High-density polyethylene
HDOP Horizontal dilution of precision
HHRA Human Health Risk Assessment

HI Hazard Index

HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine/His/Her Majesty's Explosive

HNO₃ Nitric acid

HPLC High-Pressure Liquid Chromatography

HSM Health and Safety Manager

HTRW Hazardous, Toxic, or Radiological Waste

ICAL Initial Calibration

ICP Inductively coupled plasma

ICS Interference Check Standard or Sample

ICV Initial Calibration Verification

Revision: 1 Date: September 2014

> Worksheet 1 Page 9 of 178

IDQTF Intergovernmental Data Quality Task Force

IDW Investigation-derived waste

IEUBK Integrated Exposure Uptake Biokinetic
ILCR Incremental Lifetime Cancer Risk

IS Internal Standard

Katahdin Analytical Services, Inc.

L Liter

LANL Los Alamos National Laboratory
LCS Laboratory Control Sample

LCSD Laboratory Control Sample Duplicate

LEL Lowest effects level

LIMS Laboratory Information Management System

LOD Limit of Detection

LOQ Limit of Quantitation

MC Munitions constituents

MDAS Material documented as safe

MEC Munitions and explosives of concern

MEDEP Maine Department of Environmental Protection

mg/kg Milligram per kilogram

Midlant Mid-Atlantic mL Milliliter

MPC Measurement Performance Criterion

MPPEH Material Potentially Presenting an Explosive Hazard

MRP Munitions Response Program

MRRA Midcoast Regional Redevelopment Authority

MS Matrix spike or Mass Spectrometry

MSD Matrix spike duplicate

NA Not applicable
NAS Naval Air Station

NAVFAC Naval Facilities Engineering Command

NAVSEADET Naval Sea Systems Command Detachment

NCP National Oil and Hazardous Substances Pollution Contingency Plan

NEDD NIRIS Electronic Data Deliverable

NG Nitroglycerin

NIRIS Naval Installation Restoration Information Solution
NOAA National Oceanic and Atmospheric Administration

Revision: 1 Date: September 2014

Worksheet 1 Page 10 of 178

NTU Nephelometric turbidity unit
ORNL Oak Ridge National Laboratory
ORP Oxidation-Reduction Potential

OSHA Occupational Safety and Health Administration

oz Ounce

PA Preliminary Assessment

PAH Polycyclic aromatic hydrocarbon

PCB Polychlorinated biphenyl
PDF Portable Document Format
PDOP Positional Dilution of Precision
PETN Pentaerythritol tetranitrate
PID Photoionization detector

PM Project Manager

PMO Project Management Office

POC Point of Contact

PPE Personal protective equipment
PQLG Project Quantitation Limit Goal

PQO Project quality objective
PSL Project Screening Level

QA Quality Assurance

QAM Quality Assurance Manager
QAO Quality Assurance Officer

QAPP Quality Assurance Project Plan

QC Quality Control

QSM Quality Systems Manual

%R Percent recovery

%RSD Percent Relative Standard Deviation

RDX Octahydro-1,3,5,7-tetranitro-1,3,5-triazine/Royal Demolition Explosive

RF Response Factor

RI Remedial Investigation
RPD Relative percent difference
RPM Remedial Project Manager
RRT Relative Retention Time
RSD Relative Standard Deviation
RSL Regional Screening Level

RT Retention Time

Revision: 1 Date: September 2014

Worksheet 1 Page 11 of 178

SAP Sampling and Analysis Plan

SDG Sample Delivery Group

SI Site Inspection

SIM Selected Ion Monitoring

SOP Standard Operating Procedure

SPCC System Performance Check Compound

SQB Sediment Quality Benchmarks
SQL Structured Query Language

SSL Soil Screening Level
SSO Site Safety Officer

SUXOS Senior Unexploded Ordnance Supervisor

SVOC Semivolatile organic compound

TAL Target Analyte List
TBD To be determined

TCL Target Compound List

TCLP Toxicity Characteristic Leaching Procedure

TCRA Time-Critical Removal Action
TEC Threshold Effects Concentration

Tetra Tech Inc., EC Tetra Tech EC
Tetra Tech Inc., NUS Tetra Tech NUS
2,4,6-Trinitrotoluene

TP Technical Paper

TRW Technical Review Workgroup

UFP-SAP Uniform Federal Policy for Sampling Analysis Plan

UFP-QAPP Uniform Federal Policy for Quality Assurance Project Plans

µg/dL Microgram per deciliter
USA USA Environmental Inc.

USCS Unified Soil Classification System

USEPA United States Environmental Protection Agency

UV Ultraviolet

UXO Unexploded ordnance

VPH Volatile petroleum hydrocarbons

VOC Volatile organic compound

> Date: September 2014 Worksheet 2 Page 12 of 178

SAP Worksheet #2 -- SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number:Quarry AreaContractor Name:Tetra Tech NUSContract Number:N62472-03-D-0057

Contract Title: Comprehensive Long-Term Environmental Action Navy (CLEAN)

Work Assignment Number: Contract Task Order (CTO) 69

- 1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the Intergovernmental Data Quality Task Force (IDQTF) document, *Uniform Federal Policy for Quality Assurance Plans* (UFP-QAPP) (2005) and the United States Environmental Protection Agency (USEPA) document, *Guidance for Quality Assurance Project Plans*, *QA/G-5* (2002).
- 2. Identify regulatory program: The Department of Defense (DoD) Munitions Response Program (MRP), the processes established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, Maine Department of Environmental Protection (MEDEP), and related state laws and rules, and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).
- 3. This SAP is a project-specific SAP.
- 4. List dates of scoping sessions that were held:

Scoping Session Date A specific scoping session was not hosted for this Soil/Sediment/Surface Water Remedial Investigation After the 2013 field investigations by USA Environmental Inc. (USA) and Tetra Tech NUS, the Project Team held a number of teleconferences and exchanged correspondence to develop and coordinate the efforts of the various contractors to align the proposed field work with the project objectives. The Navy communicated the general approach with regulatory agencies and stakeholders as necessary to proceed with development of this SAP. Various

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
Work Plan/QAPP for Site Inspection of Munitions and	
Explosives of Concern Areas. Site 12 EOD Area, Former	
Munitions Bunker West Area, Quarry.	June 2008
Sampling and Analysis Plan for Exploratory MEC	
Investigation of Quarry Area	October 2010
Munitions and Explosives of Concern Time-Critical Removal	
Action Work Plan for Quarry Area and Site 12 Explosive	
Ordnance Disposal Area	_August 2011, March 2012
Quarry Area Groundwater Investigation Work Plan Tech	
Memo	August 2012
Quarry Area Groundwater Investigation Work Plan	
Addendum Tech Memo	October 2013

Date: September 2014 Worksheet 2 Page 13 of 178

6. List organizational partners (stakeholders) and connection with lead organization:

Organization Partners/Stakeholders	Connection
USEPA	Regulatory Stakeholder
MEDEP	Regulatory Stakeholder
U.S. Navy	Property Owner
Town of Brunswick	Potential Future Property Owner
Bowdoin College	Potential Future Property Owner
Midcoast Regional Redevelopment Authority (MRRA)	Authority for redevelopment of former Naval Air Station (NAS) Brunswick

- 7. Lead organization: Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic (Midlant) Navy, Base Realignment and Closure (BRAC) Program Management Office (PMO) East
- 8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

Not applicable (NA) because there are no exclusions.

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Mar	nagement	
Documentation		
1	Title and Approval Page	NA
2	SAP Identifying Information	NA
3	Distribution List	NA
4	Project Personnel Sign-Off Sheet	NA
Project Organiz	ation	•
5	Project Organizational Chart	NA
6	Communication Pathways	NA
7	Personnel Responsibilities and Qualifications Table	NA
8	Special Personnel Training Requirements Table	NA
Project Planning	g/Problem Definition	
9	Project Scoping Session Participants Sheet	NA
10	Conceptual Site Model	NA
11	Data Quality Objectives	NA
12	Measurement Performance Criteria Table – Field Quality Control Samples	NA
13	Secondary Data Criteria and Limitations Table	NA
14	Summary of Project Tasks	NA
15	Reference Limits and Evaluation Table	NA
16	Project Schedule/Timeline Table	NA
B. Measureme	ent Data Acquisition	
Sampling Tasks	S	
17	Sampling Design and Rationale	NA
18	Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table	NA
19	Analytical Methods/SOP Requirements Table	NA
20	Field Quality Control (QC) Sample Summary Table – Analytical Samples	NA
21	Project Sampling SOP References Table	NA
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	NA
Analytical Task	s	
23	Analytical SOP References Table	NA
24	Analytical Instrument Calibration Table	NA
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	NA

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information	
Sample Collection	on		
26	Sample Handling System	NA	
27	Sample Custody Requirements Table	NA	
Quality Control	Samples		
28	Laboratory QC Samples Table	NA	
Data Manageme	ent Tasks		
29	Project Documents and Records Table	NA	
30	Analytical Services Table	NA	
C. Assessmen	t Oversight		
31	Planned Project Assessments Table	NA	
32	Assessment Findings and Corrective Action Responses Table	NA	
33	Quality Assurance (QA) Management Reports Table	NA	
D. Data Review	· V		
34	Verification (Step I) Process Table		
35	Validation (Steps IIa and IIb) Process Table NA		
36	Analytical Data Validation (Steps IIa and IIb) Summary Table NA		
37	Usability Assessment	NA	

Worksheet 3 Page 16 of 178

SAP Worksheet #3 -- Distribution List

Entities that will receive copies of the Final Soil/Sediment/Surface Water RI SAP, subsequent revisions, addenda, and amendments are listed below.

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Revision: 1 Date: September 2014 Worksheet 3 Page 17 of 178

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Revision: 1 Date: September 2014 Worksheet 3 Page 18 of 178

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Revision: 1 Date: September 2014 Worksheet 4 Page 19 of 178

SAP Worksheet #4 -- Project Personnel Sign-Off Sheet

(UFP-QAPP Manual Section 2.3.2)

Certification that project personnel have read the text will be obtained by one of the following methods, as applicable:

- 1. In the case of regulatory agency personnel with oversight authority, approval letters or e-mails will constitute verification that applicable sections of the SAP have been reviewed. Copies of regulatory agency approval letters/e-mails will be retained in the project files and are listed in Worksheet #29 as project records.
- 2. E-mails will be sent to the Navy, Tetra Tech NUS, and Tetra Tech NUS subcontractor project personnel requesting that they verify by e-mail that they have read the applicable SAP/sections and the date on which they were reviewed. Copies of the verification e-mails will be included in the project files and are identified in Worksheet #29.

Copies of signed Worksheets #s1 and 4 will be retained in the project files and are identified as project documents in Worksheet #29.

Name ⁽¹⁾	Organization/Title/Role	Telephone Number	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Navy and Regulator Pro	ject Team Personnel				
Todd Bober	Navy RPM/Manages project activities for Navy	215-897-4911	See Worksheet #1, Title and Approval Page	All	
TBD	NAVFAC QAO/Chemist/ Reviews SAP and QA documentation for Navy	TBD	See Worksheet #1, Title and Approval Page	All	
Tetra Tech NUS Project	Team Personnel				
Linda Klink	Tetra Tech NUS PM	412-921-8650	See Worksheet #1, Title and Approval Page	All	
Matt Soltis	Tetra Tech NUS HSM	412-921-8912	See HASP signature page	HASP	
Tim Evans	Tetra Tech NUS Maine CG	412-921-7281	See Worksheet #1, Title and Approval Page	All	

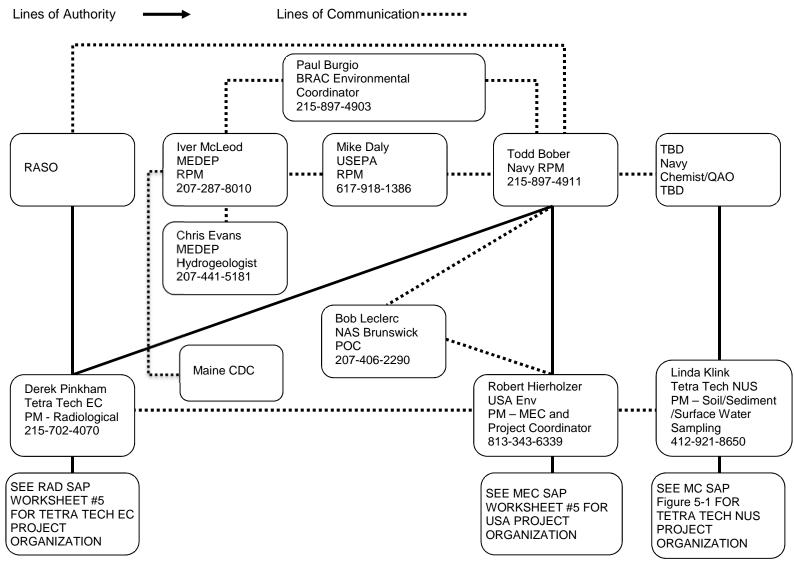
Revision: 1 Date: September 2014 Worksheet 4 Page 20 of 178

Name ⁽¹⁾	Organization/Title/Role	Telephone Number	Signature/E-Mail Receipt	SAP Section Reviewed	Date SAP Read
Brian Geringer	Tetra Tech NUS/FOL/SSO/ Manages field operation and site safety issues	978-474-8406	See Field Form – MRP FF.1 - SAP Worksheet #4 (Field Personnel) to be signed in the field	All	
Tom Johnston, PhD	Tetra Tech NUS/ QAM/Manages QA Program and implementation	412-921-8615	See Worksheet #1, Title and Approval Page	All	
Mathew Kraus	Tetra Tech NUS/Project Chemist/ Provides coordination with laboratory	412-921-8729		All	
Joe Samchuck	Tetra Tech NUS/ DVM/Manages data validation	412-921-8510		Worksheet #s12, 14, 15, 19, 20, 23- 28, 30, and 34-37	
Robert Hierholzer	USA/Project Manager	813-343-6339	See Worksheet #1, Title and Approval Page	All	
Subcontractor Personn	nel				
Jennifer Obrin	Katahdin/Laboratory PM/ Representative for laboratory and analytical issues	207-874-2400 x 17		Worksheet #s 6, 12, 14, 15, 19, 23- 28, 30, and 34-37	
Stephanie Mossburg	Microbac/Laboratory PM/ Representative for laboratory and analytical issues	800-373-4071 X 4149		Worksheet #s 6, 12, 14, 15, 19, 23- 28, 30, and 34-37	
Larry Lewis	ALS/Laboratory PM/ Representative for laboratory and analytical issues	585-288-5380		Worksheet #s 6, 12, 14, 15, 19, 23- 28, 30, and 34-37	
Paul D. Prescott	MAI Environmental/Drilling Subcontractor PM/ Provides drilling services	207-767-3663		Worksheet #s 6, 14, 17, and figures	

¹ Persons listed on this worksheet will be responsible for distributing the SAP to the appropriate people within their organization.

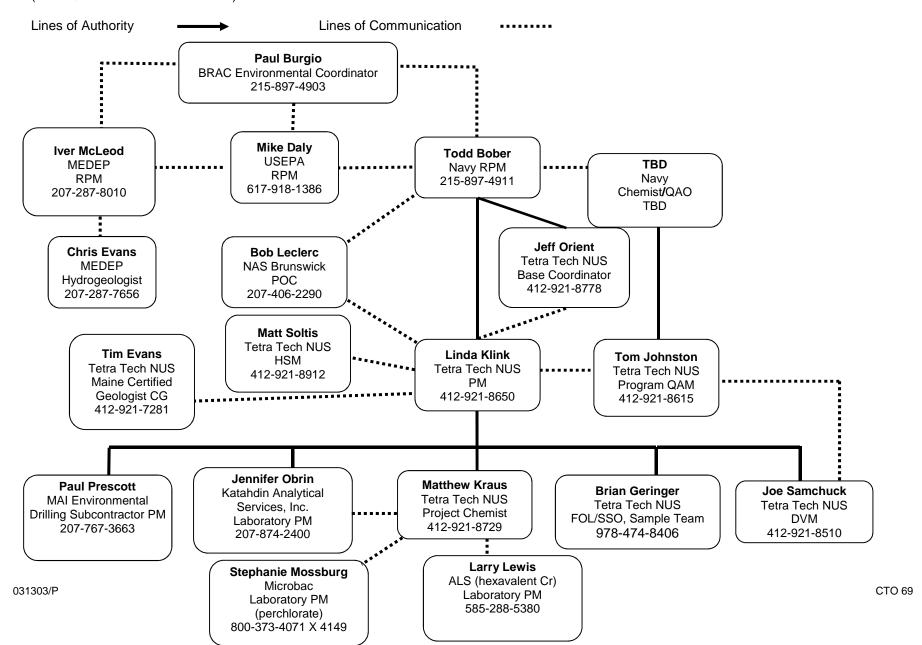
SAP Worksheet #5 -- Project Organizational Chart

The organization chart shown below represents the overall organization of the coordinated RI. The organization chart specific to Tetra Tech for the Soil/Sediment/Surface Water RI is provided as Figure 5-1 on the following page.



SAP Worksheet #5, Figure 5-1 -- Project Organizational Chart

(UFP-QAPP Manual Section 2.4.1)



Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date: September 2014 Worksheet 6 Page 23 of 178

SAP Worksheet #6 -- Communication Pathways

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Soil/sediment/ surface water sample/probing coordination	Tetra Tech FOL/SSO USA Senior Unexploded Ordnance Supervisor (SUXOS)	Brian Geringer TBD	978-474-8406 TBD	Field coordination briefings will be included with the daily safety briefing. USA informs Tetra Tech of the nature and location of the munitions and explosives of concern (MEC) investigation, and Tetra Tech informs USA of their plans for the day so that any UXO support and safety procedures are maintained.
Soil/sediment/ surface water sample/probing field progress notifications	Tetra Tech FOL/SSO Tetra Tech PM USA PM	Brian Geringer Linda Klink Robert Hierholzer	978-474-8406 412-921-8650 813-343-6339	The Tetra Tech FOL will inform verbally or via e-mail the Tetra Tech PM by noon of the following work day about the project field work schedule, findings, and issues. The Tetra Tech PM will send project updates to the USA PM via e-mail at a minimum on a weekly basis at the end of each work shift. Additional updates will be sent as needed to inform the team of issues and findings, as described below.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Soil/sediment/ surface water SAP amendments	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM USA PM USEPA MEDEP	Brian Geringer Linda Klink Todd Bober Robert Hierholzer Mike Daly Iver McLeod	978-474-8406 412-921-8650 215-897-4911 813-343-6339 617-918-1384 207-287-8010	The Tetra Tech FOL will verbally inform the Tetra Tech PM within 24 hours of realizing the need for an amendment. The Tetra Tech PM will document the proposed changes via a Field Task Modification Request (FTMR) form and send the Navy RPM a concurrence letter within 2 days of identifying the need for change, if necessary. SAP amendments will be submitted by the Tetra Tech PM to the USA PM for review and to the Navy RPM for review and approval. SAP amendments will be submitted by the Tetra Tech PM to USEPA and MEDEP for review and approval. The Tetra Tech PM will send scope changes to the Project Team via e-mail within 1 business day. The RPM or designee will inform the Project Team via e-mail within 7 business days.
Changes in field work schedule	Tetra Tech PM USA PM	Linda Klink Robert Hierholzer	412-921-8650 813-343-6339	The Tetra Tech PM will verbally inform the USA PM on the day that a schedule change related to soil and sediment sampling is known.

Date: September 2014 Worksheet 6 Page 25 of 178

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Issues in the field that result in changes in scope of field work	Tetra Tech FOL/SSO Tetra Tech PM Navy RPM USA PM USEPA MEDEP	Brian Geringer Linda Klink Todd Bober Robert Hierholzer Mike Daly Iver McLeod	978-474-8406 412-921-8650 215-897-4911 813-343-6339 617-918-1384 207-287-8010	The Tetra Tech FOL will verbally inform the Tetra Tech PM on the day that the issue is discovered. The Tetra Tech PM will inform the Navy RPM (verbally or via e-mail) and USA PM within 1 business day of discovery. The Navy RPM will issue a scope change (verbally or via e-mail), if warranted. The scope change is to be implemented before further work is executed. The Tetra Tech PM will document the change via an FTMR form within 2 days of identifying the need for the change and will obtain required approvals within 5 days of initiating the form. The RPM or designee will inform the Project Team via e-mail within 2 business days.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Recommendations to stop work and initiate work upon corrective action (CA)	Tetra Tech FOL/SSO Tetra Tech PM Tetra Tech QAM Tetra Tech Project Chemist Tetra Tech HSM Navy RPM USA PM	Brian Geringer Linda Klink Tom Johnston Matt Kraus Matt Soltis Todd Bober Robert Hierholzer	978-474-8406 412-921-8650 412-921-8615 412-921-8729 412-921-8912 215-897-4911 813-343-6339	If Tetra Tech is the responsible party for a stop-work command, the Tetra Tech FOL will inform on-site personnel, subcontractor(s), and the identified Project Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must inform the Tetra Tech FOL within 15 minutes, and the Tetra Tech FOL will then follow the procedure listed above.
CA for field program	Tetra Tech PM Tetra Tech QAM Navy RPM USA PM	Linda Klink Tom Johnston Todd Bober Robert Hierholzer	412-921-8650 412-921-8615 215-897-4911 813-343-6339	The Tetra Tech QAM will notify the Tetra Tech PM verbally or by e-mail within 1 business day that the CA has been completed. The Tetra Tech PM will then notify the USA PM and Navy RPM (verbally or by e-mail) within 1 business day
Field data quality issues	Tetra Tech FOL/SSO Tetra Tech PM	Brian Geringer Linda Klink	978-474-8406 412-921-8650	The Tetra Tech FOL will inform the Tetra Tech PM (verbally or via e-mail) on the same day that a field data quality issue is discovered.

Communication Driver	Responsible Affiliation	Name	Phone Number and/or E-Mail	Procedure
Analytical data quality issues	Katahdin Laboratory PM Microbac Laboratory PM ALS Laboratory PM Tetra Tech Project Chemist Tetra Tech DVM Tetra Tech PM Navy RPM	Jennifer Obrin Stephanie Mossburg Larry Lewis Matt Kraus Joseph Samchuck Linda Klink Todd Bober	207-874-2400 800-373-4071 X 4149 585-288-5380 412-921-8729 412-921-8510 412-921-8650 215-897-4911	The Laboratory PM will notify (verbally or via e-mail) the Tetra Tech Project Chemist within 1 business day of when an issue related to laboratory data is discovered. The Tetra Tech Project Chemist will notify (verbally or via e-mail) the data validation staff and Tetra Tech PM within 1 business day. The Tetra Tech DVM or Project Chemist will notify the Tetra Tech PM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant laboratory quality deficiency has been detected that could affect this project and/or other projects. The Tetra Tech PM will verbally advise the NAVFAC RPM within 24 hours of notification from the Project Chemist or DVM. The NAVFAC RPM will take CA that is appropriate for the identified deficiency. Examples of significant laboratory deficiencies include data reported that have a corresponding failed tune or initial calibration verification. CAs may include a consult with the NAVFAC Navy Chemist.

SAP Worksheet #7 -- Personnel Responsibilities and Qualifications Table (UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities
Todd Bober	Navy RPM/Manages project activities for the Navy	NAVFAC Midlant	Oversees project implementation including scoping, data review, and evaluation.
Paul Burgio	BRAC Environmental Coordinator)/Manages BRAC activities for the Navy	BRAC PMO East	Coordinates BRAC environmental activities for the Navy.
TBD Navy Chemist	NAVFAC QAO/Chemist/ Reviews SAP and QA documentation for Navy	NAVFAC	Reviews SAP and QA documentation for Navy
Bob Leclerc	Installation POC	NAS Brunswick Caretaker's Office	Coordinates and oversees activities on the former NAS Brunswick facility.
Iver McLeod	RPM/Provides regulator input	MEDEP	Participates in scoping, conducts data review and evaluation, and approves the SAP on behalf of MEDEP.
Chris Evans	MEDEP Hydrogeologist/ Provides MEDEP regulator input	MEDEP	Participates in scoping, conducts data review and evaluation, and provides input on the SAP on behalf of MEDEP.
Jeff Orient	Base Coordinator/Oversees project activities	Tetra Tech NUS	Oversees project implementation including scoping, data review, and evaluation for all Tetra Tech projects at NAS Brunswick.
Michael Daly	RPM/Provides USEPA regulator input	USEPA	Participates in scoping, conducts data review and evaluation, and approves the SAP on behalf of USEPA.
Linda Klink	PM/Manages project on a daily basis	Tetra Tech NUS	Oversees project, financial, schedule, and technical day-to-day management of the project. Responsible for the soil, sediment, and surface water sampling and probing and overall execution of the SAP, and development of the risk assessment for potential contaminants.

CTO 69 031303/P

Date: September 2014 Worksheet 7 Page 29 of 178

Name	Title/Role	Organizational Affiliation	Responsibilities
Brian Geringer	FOL/SSO/Manages field operations and oversees site activities to ensure that safety requirements are met	Tetra Tech NUS	As FOL, supervises, coordinates, and performs field sampling activities. As SSO, is responsible for on-site project-specific health and safety training and monitoring site conditions regarding soil, sediment, and surface water sampling and lithology boring. Details of these responsibilities are presented in the HASP. Responsible for direct coordination with USA field management team for safe and efficient execution of their work.
Tim Evans	Maine CG/Provides technical support	Tetra Tech NUS	Provides technical support and reviews geologic and hydrogeologic interpretations of site data.
Tom Johnston	QAM/Oversees program and project QA activities	Tetra Tech NUS	Ensures that quality aspects of the CLEAN Program are implemented.
Matt Soltis	HSM/Oversees health and safety activities	Tetra Tech NUS	Oversees the Tetra Tech CLEAN Program Health and Safety Program.
Matt Kraus	Project Chemist/Conducts project oversight of data validation and reporting	Tetra Tech NUS	Participates in project scoping, prepares laboratory scopes of work, and coordinates laboratory-related functions with the laboratory. Oversees data quality reviews and QA of data validation deliverables.
Joseph Samchuck	DVM/Oversees data validation activities	Tetra Tech NUS	Manages data validation activities within Tetra Tech, including QA of data validation deliverables, providing technical advice on data usability, and coordinating and maintaining the data validation review schedule.
Lee Leck	Data Manager/Oversees database activities	Tetra Tech NUS	Manages Tetra Tech databases and ensures input of data.
Jennifer Obrin	Laboratory PM/Manages project	Katahdin	Coordinates analyses with laboratory chemists, ensures that the scope of work is followed, provides QA of data packages, and communicates with Tetra Tech project staff.
Stephanie Mossburg	Laboratory PM/Manages project	Microbac	Coordinates analyses with laboratory chemists, ensures that the scope of work is followed, provides QA of data packages, and communicates with Tetra Tech project staff.
Larry Lewis	Laboratory PM/Manages project	ALS	Coordinates analyses with laboratory chemists, ensures that the scope of work is followed, provides QA of data packages, and communicates with Tetra Tech project staff.

Revision: 1 Date: September 2014 Worksheet 7 Page 30 of 178

Name	Title/Role	Organizational Affiliation	Responsibilities
Paul D. Prescott	Drilling subcontractor PM/ Provides drilling services	MAI Environmental	Performs lithology and soil boring installation according to the scope of work.

In some cases, one person may be designated responsibilities for more than one position. For example, the Tetra Tech FOL will be responsible for SSO duties. This action will be performed only as credentials, experience, and availability permits.

Revision: 1

Date: September 2014 Worksheet 8

Page 31 of 178

SAP Worksheet #8 -- Special Personnel Training Requirements Table

(UFP-QAPP Manual Section 2.4.4)

Each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response (HAZWOPER) training as specified in the Occupational Safety and Health Administration (OSHA), 29 Code of Federal Regulations (CFR) 1910.120(e). Project-specific safety requirements are addressed in detail in the site-specific HASP/Accident Protection Plan (APP).

Unexploded Ordnance (UXO) anomaly avoidance personnel must be trained in accordance with Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18; this requires that the UXO Technicians performing anomaly avoidance be certified by DoD. A qualified UXO Technician will be used to fulfill the anomaly avoidance requirements necessary to support the Tetra Tech Munitions Constituents (MC) sampling efforts.

Revision: 1

Date: September 2014 Worksheet 9

Page 32 of 178

SAP Worksheet #9 -- Project Scoping Session Participants Sheet

(UFP-QAPP Manual Section 2.5.1)

A specific scoping session was not held for this Soil/Sediment/Surface Water RI. After the 2013 field investigations by USA and Tetra Tech NUS,

the Project Team held a number of teleconferences and exchanged correspondence to develop and coordinate the efforts by the various

contractors to align the proposed field work with the project objectives. The Navy communicated the general approach with regulatory agencies

and stakeholders, as necessary, to proceed with development of this SAP.

Overall, this project includes the investigation of the following three different types of potential contaminants:

MEC

Soil, sediment, surface water, and groundwater contamination from MC and other CERCLA-listed contaminants

RAD

USA is the contractor responsible for the MEC RI, general coordination of the three studies listed above and completion of a comprehensive FS.

They have developed a SAP for their scope of work. Tetra Tech NUS is responsible for continuation of the soil, sediment, and surface water

contamination investigation. Groundwater data was collected during previous investigations as discussed below. Tetra Tech EC is the contractor

responsible for the RAD investigation; they have developed specific work plans for their field work at the Quarry Area. Parsons is subcontracted

by USA to evaluate the risk assessments and prepare the comprehensive FS.

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date: September 2014 Worksheet 10 Page 33 of 178

SAP Worksheet #10 -- Site History and Background

Profile Type	Information Needs	MC/MEC Investigation Findings		
Range/Site	Installation Name	Former NAS Brunswick, disestablished May 30, 2011 (see Figure 10-1).		
Profile	Installation Location	Cumberland County, Maine		
	Range/Site Name	Quarry Area		
	Range/Site Location	The Quarry Area is located about 1,800 feet southwest of the runways at former NAS Brunswick's western boundary, adjacent to Maine State Route 123 (Harpswell Road), referred to herein as SR123.		
	Range/Site History	Rock quarrying activities took place at the site in the 1940s and 1950s. A report discussed in the 2006 Preliminary Assessment (PA) Report indicated that the site might have been used for past explosives ordnance disposal (EOD) activities. Former NAS Brunswick personnel indicated that any EOD activities were limited to burning/treatment of small arms. Land farming to remediate petroleum-contaminated soil was known to have been conducted at the site from 1992 to 1995, and landfarming activities appear to have been limited to previously quarried areas in the central portions of the site. Significant amounts of debris including partially buried scrap metal, tires, and concrete were observed, especially along the rock face at the eastern end of the Quarry Area during the 2007 Site Inspection (SI) site visit. Hazardous, Toxic, or Radiological Waste (HTRW) is not anticipated at the Quarry Area, and no historical documentation has indicated that HTRW was stored, disposed of, or generated at this site. However, although radiological debris is not expected, it is possible because landfilling activities occurred; therefore, a radiological survey will be conducted in this quarried backfill area during the soil/sediment/surface water RI. Digital geophysical mapping (DGM) conducted in 2008 and excavation of subsurface anomalies in 2010 indicated that landfilling of non-munitions debris may also have occurred at the site and appears to have been associated with areas identified as the former borrow pit. Based on the munitions debris identified during the MEC investigations to date, the site appears to have also been used for some undetermined munitions activity (disposal, detonation, or both) in addition to the reported small arms treatment discussed above.		

Profile Type	Information Needs	MC/MEC Investigation Findings
	Range/Site Area and Layout	Initial boundaries of the Quarry Area were provided by former NAS Brunswick Environmental Office personnel for the 2007 PA Report. The Quarry Area originally comprised approximately 4 acres based on the 2007 PA Report. This area is referred to as the Quarry MRS. The area of investigation has been expanding during previous activities, and the proposed investigation boundary for the Quarry Area is now approximately 80 acres, and includes areas north, south and east of the original site boundary and area west of the site and west of SR123. It is expected that the Quarry MRS boundary will be redefined within the area shown on Appendix A of this SAP, Figure 2, after evaluating results of the proposed coordinated RI. A 20- to 30-foot rock face is present along the eastern boundary of the central Quarry Area. Old Route 24 bisects the site, and the Radar Tower Access Road and SR123 (Harpswell Road) border the site on the west. The majority of the site north of Old Route 24 is within the Quarry Area fence installed in 2011. Based on the 2012 Time-Critical Removal Action (TCRA) Investigation, and 2013 step-out clearance, additional MEC investigation).
	Range/Site Structures	A radar tower (Building 646) is located just north of the current Quarry MRS boundary and within the area of investigation. There are no other structures located within the Quarry Area investigation area.
	Range/Site Boundaries	N: Undeveloped land (pine forest) north of the radar tower and Radar Tower Access Road S: Undeveloped land (pine forest) E: Former NAS Brunswick runway W: Undeveloped land (pine forest) west of SR123 pavement plus exclusion zone. Further investigation west of SR123 will be conducted, provided that right of entry permission from landowner is obtained.
	Range/Site Security	Access to the Quarry MRS and radar tower is restricted by an unguarded but locked gate. The wooded areas south of Old Route 24 are readily accessible by foot. The remaining wooded areas are mostly enclosed with chain-link fence, but the fencing is not complete. Therefore, only the area within the locked chain-link fence that encloses the Quarry MRS and radar tower is considered relatively secure. The other areas are not easily accessible, and the existing fencing is a deterrent to trespassing.

Profile Type	Information Needs	MC/MEC Investigation Findings
Munitions/ Release Profile	Munitions Types	Based on 2010 the MEC Exploratory Investigation, 2011 through 2012 TCRA Investigations, and 2013 step-out clearance, 2.75- and 3.5-inch rocket components (i.e., rocket motors, fuzes, and warhead fragments from demolition), pyrotechnics (flares and signals), rifle grenades, practice hand grenade fuzes, and small arms ammunition exist within the investigation area.
	Maximum Probability Penetration Depth	There are no known impact or target areas within the investigation area or surrounding areas. Because MEC was not fired into or dropped onto the site, penetration depths are not applicable. However, based on the trenching results of the 2010 through 2012 MEC investigations (Tetra Tech, 2013), MEC items were found buried to a depth of approximately 2.5 feet below ground surface (bgs) within the Quarry MRS. Additionally, disturbed soil and non-munitions-related debris were found up to 4 feet bgs. Because the site history regarding munitions activities is unclear, munitions-related items may be found anywhere within the reworked material as a result of demolition operations and disposal of munitions debris with other landfilling activities. MEC and other munitions debris items found outside of the Quarry MRS were less than 1 foot bgs, with over 90 percent within the top 6 inches of soil.
	MEC and Material Potentially Presenting an Explosive Hazard (MPPEH) Density	More generally, MEC/MPPEH density is low across the site, with isolated munitions items found primarily within and just outside of the Quarry MRS, as shown in Appendix A of this SAP, Figure 2. In several areas, small higher density collections of munitions items were identified where they were apparently buried. Occasional MEC/MPPEH items were recovered on the ground surface and in the shallow sub-surface several hundred feet east and south of the Quarry MRS fence line. No MEC items have been identified in the area northwest of the Radar Tower Access Road or in the southwestern portion of the Quarry Area within the fence. However, the subsurface in these areas was not fully investigated. It is anticipated that MEC/MPPEH is located in the uninvestigated areas north of the Quarry MRS and possible further to the east at a frequency (density) similar to what was found so far.

Profile Type	Information Needs	MC/MEC Investigation Findings
	Munitions Debris	Munitions debris was not identified during the visual survey conducted during the PA. One 2.75-inch rocket tail fin assembly was discovered during the 2008 MEC SI. Numerous material documented as safe (MDAS) items were identified within the MRS during trenching operations (2010). MDAS included 2.75-inch rocket warheads and motor parts, 3.5-inch rocket warheads (with and without fuzes), M405 dummy fuzes, MK31 MOD 0 day/night signal, flares, several unknown fuzes and components, 2.36-inch rocket components, M1-grenade fuze bodies, 40-millimeter cartridges, fragments, and miscellaneous munitions-related debris such as spent casings. More MDAS was found outside of the MRS boundary during the UXO detector-aided surface surveys and during manual intrusive investigations from 2010 through 2013. Most of the MDAS items were fragments from exploded munitions (frag) or exhibited damage/deformation from demolition events. During the 2013 step-out clearance, debris related to training exercises was found on the surface and in small concentrations of buried debris. These items included clips for M1 Garand small arms casings (some belted) and practice hand grenade parts. The training that occurred appears unrelated to the demolition operations conducted at the site.
	Associated MC (and other chemicals of potential concern (COPCs)	Potential soil/sediment/surface water MC are metals, explosives [trinitrotoluene (TNT), octahydro-1,3,5,7-tetranitro-1,3,5-triazine/Royal Demolition Explosive (RDX), octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine/His/Her Majesty's Explosive (HMX)], propellants [nitroglycerin (NG)], and for groundwater and surface water also perchlorate. (Hexavalent chromium is not expected but will aid in reducing uncertainty for the human health risk assessment). These contaminants would be expected to be found in the detonation area and kickout areas of the site. Additionally, based on the 2010 Exploratory MEC Investigation, low-level petroleum-related contamination is also present in soil in the landfarming area. Also in the quarried backfill area, other non-MC related contaminants may potentially be present including volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs) including low-level polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), extractable petroleum hydrocarbons (EPH), and volatile petroleum hydrocarbons (VPH). Results from the 2012 and 2013 groundwater investigations indicate mainly low concentrations of petroleum-related VOCs (benzene and xylenes), perchlorate, and explosives in groundwater (compared to screening criteria).
	Migration Routes/Release Mechanisms	A potential MEC migration route includes frost heave/erosion, which can facilitate migration of MEC/MPPEH items from the subsurface to the surface. Potential MC migration routes include leaching of contaminants in soil to groundwater and runoff of surface soil contaminants to sediment and surface water (Figure 10-2).

Profile Type	Information Needs	MC/MEC Investigation Findings
Physical Profile	Climate	The area has a continental climate with three well-defined seasons. Highest temperatures occur in July [79 degrees Fahrenheit (°F) or higher], and coldest temperatures occur in January (21°F or lower).
	Topography	Topography contours are provided on Figures 3 and 4, Appendix A of this SAP. The steepest terrain is a 20- to 30-foot rock face along the southeastern boundary of the site where past quarrying activities were conducted. Slopes across the remainder of the investigation area are typically less than 30 percent with many relatively level areas.
	Geology	The geology of the Quarry Area varies across the site for both unconsolidated materials and bedrock. These findings are consistent with the history of the site, which included extensive quarrying of the bedrock, development of the access road for the radar tower, disposal of construction debris, and land-spreading activities during which several feet of fill material from elsewhere on base were disposed of into the central quarry area. Within the former quarry (central area of site), a thin veneer of unconsolidated material is present overlying bedrock. West of the central area, the bedrock surface dips to the west, and unconsolidated material is encountered to approximately 30 feet. East of the central area, clay and silt are encountered within the bedrock valley, with bedrock dipping to the northeast. Three geological cross sections and a bedrock surface map have been generated and are provided in Appendix C. Unconsolidated materials include fill and reworked material within the boundaries of the former quarry, and fine to medium sand, silt, or clay (interpreted as the Presumpscot Clay) in areas outside the former quarry and directly adjacent to the site, and bedrock was encountered at depths to 31 feet bgs farther away from the former quarry, depending on location. Bedrock is identified as the Cushing Formation, with amphibolite and granofels rock types present. Both rock types were observed to strike northeast-southwest, have steeply dipping foliation to the east, and have fracturing along the foliation as well as subhorizontal fracturing.
Soil	Soil in the area is the Windsor-Hinckley-Deerfield Association, which is characterized as deep, excessively to moderately well-drained, nearly level to steep, coarse-textured soil. Surface materials at the Quarry Area consist of approximately 0 to 6 inches of topsoil and 1.5 to 6.0 feet of reworked soil material, consisting of varying quantities of fine to medium sand, silt, and gravel. The depths of disturbed soil/fill are variable throughout the site due to quarry and borrow historical operations. Approximately 30 inches of fill material (soil, construction debris, etc.) are known to be present within the land-farming area in the eastern portion of the central Quarry Area.	

Profile Type	Information Needs	MC/MEC Investigation Findings
	Hydrogeology	Groundwater is unconfined in the Quarry Area, with the exception of the eastern area of the site, which is under confined conditions due to the presence of low-permeability silts and clay. Within the former limits of the quarry (central area) and along the southern and eastern limits of the groundwater investigation (2013), groundwater is present in the bedrock. In the western portions of the investigation, groundwater occurs in the overburden sand (Upper Sand), above the clay unit or bedrock.
		Groundwater head elevations appear to be seasonally variable (i.e., August 2012 conditions were drier than December 2013 conditional). A groundwater divide is present along the bedrock ridge that trends northeast-southwest through the site; groundwater flow is to the northwest west of the quarry wall and to the northeast east of the quarry wall. Groundwater follows (principally) topography in the Quarry Area. East of the bedrock ridge, groundwater is present in the bedrock and transitions to the overburden. The head elevations are consistent between bedrock and overburden units, confirming the transition. The groundwater seepage velocity for the overburden was calculated to be 0.25 foot per day (92 feet per year), and the groundwater seepage velocity of the shallow bedrock was calculated to be 0.30 foot per day (110 feet per year). Per recent aerial photography of the area, the closest house is located approximately 1,300 feet from the center of the Quarry site.
	Hydrology	During the MEC Exploratory Investigation, a small pool of standing water was observed along the rock face at the southeastern boundary of the Quarry Area, and ponding was observed in low-lying areas. Generally, surface water drains in a southwesterly direction, but surface drainage from the central Quarry Area follows topography to the west toward a culvert that crosses Harpswell Road (SR123) and south across Old Route 24. Surface water also appears seasonally in drainage areas located near the base of the rock wall and south of Old Route 24 near a culvert that runs under the road and drains the central Quarry Area. A significant vernal pool exists just south of this area as shown on Figures 2 and 3 of Appendix A of this SAP. The depth varies depending on rainfall and groundwater conditions. It is estimated to be up to 2-feet deep at the deepest location and during wet conditions. It may also drain completely at times.
	Vegetation	Vegetation at the site consists of tall grasses and maple and pine trees. The forested areas consist of dense mature trees with very little understory. Road rights-of-way and utility corridors, as well as the perimeter and central areas of the Quarry MRS have thick grasses and understory. Based on review of historical aerial photographs, the Quarry MRS has essentially "overgrown" since use of the site for landfilling or other material operations was completed.

Profile Type	Information Needs	MC/MEC Investigation Findings					
Land Use and Exposure Profile	Current Land Use	The Quarry Area is not being used due to the identification of munitions-related items at the site. The Quarry Area fence installed in 2011 limits access to the majority of the site. No formal administrative land use controls are in place for the site at this time.					
	Current Human Receptors	Current receptors include potential trespassers and contractors performing site remedial tasks.					
	Current Activities	Currently, no base or public activities take place on this site, with the exception of the current MEC/environmental investigation in progress.					
	Potential Future Land Use	Potential future land use of the area has been designated as "College Use Conservation District (Education/Natural Area)" use and/or 'Education/Mixed Use Space" (south of Old Route 24, only).					
	Potential Future Human Receptors	Potential future human receptors are expected to be low-intensity recreational users (i.e., the public).					
	Potential Future Land Use- Related Activities	Potential future land use-related activities include low-intensity activities such as bird watching, hiking, and educational uses.					
	Zoning/Land Use Restrictions	There are currently no Quarry Area-specific restrictions; however, following the May 30, 2011, disestablishment of the base, the Navy installed a fence around the waste disposal area of the site.					
	Demographics/Zoning	Cumberland County population density is approximately 50,000 people per square mile.					
	Beneficial Resources	There are no Quarry Area-specific beneficial resources.					
	Cultural Resources	No archeological environmentally sensitive areas are present.					
	Habitat Type	Habitat consists of forest and a grassy field, small creek along the southern boundary, and a significant vernal pool is located southwest of the Quarry MRS across Old Route 24.					
	Degree of Disturbance	Low – for current land use; the Quarry Area site is currently unused. Low – for future land use, which is currently designated as low-intensity activities only as described above. The habitat and ecological receptors present are and will be generally undisturbed; however, a fence has been installed that reduces the potential for ground-dwelling ecological receptors to access the waste disposal area of the site.					
	Ecological Receptors and Species of Special Concern	Based on the available habitat at the site, ecological receptors include herbivorous mammal – meadow vole; herbivorous bird – bobwhite quail; insectivorous mammal – short-tailed shrew; and, insectivorous bird – American robin. No species of special concern are known to inhabit the site.					

Date: September 2014 Worksheet 10 Page 40 of 178

Profile Type	Information Needs	MC/MEC Investigation Findings
Ecological Profile	Relationship of MEC/MC Sources to Habitat and Potential Receptors	The ground surface of the Quarry Area extending to and including the 2013 step-out areas has been cleared of munitions-related items. Human and ecological receptors may come into direct contact with MEC/MC on the surface outside of the previously cleared areas or in the cleared area if an item migrated to the surface after clearance as a result of erosion or frost heave. Ecological receptors, may encounter munitions hazards in the subsurface while burrowing.
		Receptors may come into contact with MC (and low-level petroleum-related contamination) that have been incorporated into the food chain (bioaccumulated in plants and animals) (e.g., deer that forage in the area may come into contact with MC by consuming plants that have incorporated MC.) Ecological receptors could be exposed to potential MC (and low-level petroleum-related contamination) in the subsurface while digging for food or constructing burrows. However, this possibility was somewhat reduced for ground-dwelling animals when the Quarry Area fence was installed.

Revision: 1

Date: September 2014 Worksheet 11 Page 41 of 178

SAP Worksheet #11 -- Project Quality Objectives/Systematic Planning Process Statements

(UFP-QAPP Manual Section 2.6.1)

PROJECT DESCRIPTION

In support of the Tetra Tech NUS portion of the Quarry Area RI focused on CERCLA lithology and chemical contamination investigation, project

quality objectives (PQOs) are presented in this section that document the environmental decisions needed as well as the level of data quality

necessary to support these decisions.

As detailed in the conceptual site model (CSM) of Worksheet #10 and shown on Figure 10-2, within the central quarried area of the site,

subsurface landfilling occurred that included munitions items, trash, and construction debris; items including empty drums were also encountered

on the ground surface. In a 1958 topographic map, the quarry borrow pit was approximately 6 feet bgs in the central portion of the quarry area

which is consistent with the depth to bedrock and the thickness of reworked material depicted on the cross sections within the guarry boundaries

provided in Appendix C. Moreover, land-farming activities occurred in the 1990s on the ground surface in the west central guarried area of the site

to treat 350 to 450 cubic yards of petroleum-contaminated soil transported from elsewhere at the base. The landfarming activities appear to have

been limited to previously quarried areas in the central portions of the site. A fence was installed in 2011 enclosing the central quarried area of the

site to prevent access by recreational users. Beyond the central area of the site to the southeast, there appears to have been an open detonation

area, based on the density and pattern of MEC/MPPEH findings of kickout munitions items encountered to date. It is noted that additional

detonation areas may be identified during the MEC portion of the investigation. Historical munitions training operations are also suspected. There

are no known impact or target areas within the investigation area or surrounding areas, MEC was not fired into or dropped onto the site. However,

based on the trenching results of the 2010 through 2012 MEC investigations, MEC items were found buried to a depth of approximately 2.5 feet

below ground surface (bgs) within the Quarry MRS. Additionally, disturbed soil and non-munitions-related debris were found up to 4 feet bgs.

Because the site history regarding munitions activities is unclear, munitions-related items may be found anywhere within the reworked material as

a result of demolition operations and disposal of munitions debris with other landfilling activities. Based on these previous site operations,

chemical contaminants may have been released to surface or subsurface soils and sediment in the form of MC or non-munitions-related

/petroleum waste from landfarming activities. These chemicals could pose an unacceptable level of risk to human and/or ecological receptors. In

addition, if chemical release occurred, the chemicals may have migrated to other environmental media such as groundwater and surface water,

Revision: 1

Date: September 2014 Worksheet 11

Page 42 of 178

which could also pose an unacceptable level of risk to human and/or ecological receptors. Moreover, if filling of borrow areas with contaminated

soil/fill occurred, contamination could be in direct contact with groundwater. Therefore, the Project Team must determine the nature and extent of

contamination, if present, and must assess the level of human health and ecological risks so that appropriate action can be taken, as necessary,

to be protective of human health and the environment.

Soil, sediment, and surface water sampling and analysis are necessary, as well as a refinement of the understanding of the geology at the site. In

addition, soil sample data collected during the 2010 trenching investigation of subsurface anomalies are required to complete the risk assessment

to be completed as part of the MC RI. MEC investigation is ongoing, and refinement of the boundaries of the site on all sides is planned, as

detailed in the separate MEC SAP prepared by USA. Also, groundwater data from the 2012/2013 investigations will be incorporated into the risk

assessment along with soil, sediment, and surface water data collected during this investigation. To establish PQOs for the site, the USEPA's

seven-step Data Quality Objective (DQO) process was followed (2005b).

A Decision Unit (DU) is defined as the smallest area about which a risk-based decision can be made. Based on the CSM, the Quarry Area has

been divided into six primary DUs (DU1 through DU6) selected to account for anticipated differing contaminant sources (MC or non-munitions-

related waste) and concentrations (see Figure 11-1 and Table 17-1). The DUs include:

DU1 – Quarried Backfill Area North of Radar Tower Access Road

DU2 – Quarried Backfill Area Inside Quarry Fence

DU3 – Landfarming Area

DU4 – Detonation Area and Kickout Area

DU4a – Detonation Area

DU4b – Kickout Area

DU5 – Seasonal Drainage Areas

DU 6 – Groundwater (monitoring wells were installed and groundwater samples collected in 2012 and 2013).

Revision: 1

Date: September 2014 Worksheet 11

Page 43 of 178

DUs may be combined into exposure units (EUs) for use in risk assessment after the field program is complete and the analytical results are

known. An EU is the area over which site receptor activity is expected to occur. The two most important considerations in defining an EU are the

anticipated receptor activity and the spatial distribution of contaminant concentrations. Exposure units will be determined following data collection

by comparing chemical concentration distributions in DUs to each other to determine whether or not DUs with similar chemical distributions can be

combined. If chemical data from any give DU cannot be combined with another DU to form an EU than that DU will be evaluated as an individual

EU. The horizontal boundaries of DU2, DU3, and DU4b overlap (see Figure 11-1). In the overlap areas, the DU2, DU3, and DU4b boundaries are

distinguished by their vertical profile. DU4b, Kickout Area, is surficial because kickout items would have landed on the surface, and MEC would be

the primary concern in this area, with the boundary correlated with presence of munitions items. DU3, Landfarming Area, is expected to occupy

an area at depths of 0 to up to 3 feet bgs. Materials associated with the landfarming area (DU3) were placed on top of the previously quarried

backfill area (DU2), and within the overlap area, DU2 may begin at depths of approximately 3 feet bgs. The actual depths of quarrying activities

and vertical extent of landfarming activities are unknown at this time and must be evaluated during the subject subsurface investigation.

WHO WILL USE THE DATA?

The data generated during the Tetra Tech NUS portion of the RI will aid the Department of the Navy, NAVFAC Midlant and other project

stakeholders in determining the path forward for the site. Geologists will use the lithology data to identify natural conditions and evaluate areas of

historical waste disposal, landfarming, and munitions detonation. Chemists will use the soil, sediment, and surface water chemical data to

evaluate overall data quality and usability by preparing a data quality evaluation (see Worksheet #37), and chemists will also combine the lithology

and chemical results to delineate the nature and extent of contamination. Risk assessors will use the soil, sediment, and surface water data, in

combination with previously collected groundwater data, to evaluate data usability and to support associated human health and ecological risk

assessments.

WHAT ARE THE PROJECT ACTION LIMITS?

The data will ultimately be used for risk assessment purposes; therefore, the laboratory Limits of Quantitation (LOQs) must be low enough to

measure constituent concentrations at or less than Project Screening Levels (PSLs) (see Worksheet #15). PSL backup tables are provided in

Appendix B. In cases where conventional test methods are not able to achieve LOQs less than PSLs (such as for arsenic and selected

Revision: 1

Date: September 2014 Worksheet 11

Page 44 of 178

explosives), conventions for evaluating the data are described below that will help the stakeholders determine with reasonable satisfaction

whether the constituent poses a potentially unacceptable risk. Analytical data reported by the laboratory must use the following reporting

conventions:

All concentrations less than detection limits (DLs) will be classified as non-detects and will be reported as Limits of Detection (LODs) values

with "U" qualifiers.

Concentrations between LOQs and DLs will be reported as estimated values with "J" qualifiers.

The "J" flagged data will be accepted to achieve project goals. The inability to quantifiably compare individual analytes to PSLs with confidence

must be discussed in the risk evaluation uncertainty analysis in each risk assessment. Qualified groundwater data is provided in the Technical

Memorandum Groundwater Report provided in Appendix C (Tetra Tech, 2014).

The analytical data must be compared to PSLs for the selection of soil, sediment, surface water, and groundwater COPCs in the Human Health

Risk Assessment (HHRA) and Ecological Risk Assessment (ERA). Groundwater results will also be compared to surface water PSLs in the ERA

because groundwater discharges to seasonal drainage areas at the Quarry Area. PSLs for soil, sediment, and surface water are identified in

Worksheet #15; the minimum value of all applicable criteria that were considered is presented as the PSL for each chemical.

WHAT WILL THE DATA BE USED FOR?

The analytical results will be used to determine whether the site poses a risk to human health and/or the environment based on comparisons to

applicable threshold criteria and/or background concentrations. Although some samples were pre-determined to obtain lithology/sampling

coverage of the site and associated DUs, lithology data will be used to make in-field decisions about whether to collect samples for laboratory

analysis (e.g., evidence of waste disposal, drum, etc.) at select locations.

The data will be used to support nature and extent of contamination delineation, understanding of fate and transport of contaminants in the

environment, and evaluation of associated human health and ecological risk. Subsequently, the body of data will support decisions by the

stakeholders for the site path forward, including whether further action is required.

Revision: 1

Date: September 2014 Worksheet 11

Page 45 of 178

In support of risk assessment, existing sources of background data for_metals, PAHs, and pesticides will be used to differentiate between site-

related chemicals and those chemicals occurring naturally or through anthropogenic inputs, as further described in Appendix D - HHRA

Methodology and Appendix E –ERA Methodology. The source of background data will include the NAS Brunswick facility background values

identified in the Background Study Report for Naval Air Station Brunswick (Tetra Tech, 2012a) and MEDEP background values. The Quarry site

has a complex and varied geology and hydrogeology; therefore, comparison of site data to background data requires matching of the sample data

as closely as possible with its appropriate background data category. Depending on the locations and conditions of soil encountered in the field,

facility background Mixed Soil, Upper Sand, or Transition Unit classifications will be used. For groundwater, classification will be based on the well

screen depths and previously established lithology from monitoring well installation; generally, data from monitoring wells located in the

northeastern portion of the site will be compared to "Upper Sand Fall" background data, and monitoring wells located in the remainder of the site

will be compared to "Bedrock Fall" background data.

The risk assessment goal for this project is to determine potential cumulative site risks across all media to which a given receptor may be

exposed. In addition to the site-specific HHRA and ERA, a cumulative risk assessment that includes risks from chemicals screened out at the

COPC selection phase of the site-specific risk assessment due to background comparisons will be completed for informational purposes.

Potential risks to receptors will be calculated for each EU. The two most important considerations in defining an EU are anticipated receptor

activity and spatial distribution of contaminant concentrations. Whereas data collection is being guided by the existence of areas called DUs, EUs

cannot be determined at this time and must be determined following evaluation of chemical distribution data of the individual DUs, with

consideration of expected receptor activity based on current and potential future land use. Risk assessments are needed to provide an evaluation

of both munitions- and non-munitions-related substances that may pose potentially unacceptable risks to receptors exposed to site media under

current and hypothetical future land use. The methodologies for HHRA and ERA are provided in Appendices D and E, respectively. These risk

assessments must be conducted in accordance with USEPA protocols and Navy guidance documents for HHRAs and ERAs.

Revision: 1 Date: September 2014

Worksheet 11 Page 46 of 178

WHAT TYPES OF DATA ARE NEEDED (MATRIX, TARGET ANALYTES, ANALYTICAL GROUPS, FIELD SCREENING, ONSITE ANALYTICAL OR OFFSITE LABORATORY TECHNIQUES, SAMPLING TECHNIQUES)?

Media of Interest: Surface soil, subsurface soil, sediment, and surface water are the media of interest needing data to understand the complex site history that includes quarrying, use of the site as a borrow pit, landfilling, and land-farming events. COPC concentrations are not expected to change significantly in soil, sediment, or surface water during the course of this investigation because the site is no longer in use and the base has been disestablished. Note that surface water in the Quarry area is intermittent and surface water samples will only be collected if surface water is present in the seasonal drainage areas during sampling. In these areas, sediment is expected to be the most likely medium in which to detect contamination because contaminants, if any, are expected to adsorb to fine-grained sediments. Aquatic organisms are not expected to be present in surface water in the seasonal drainage areas because surface water is only present intermittently during periods of surface water runoff.

For groundwater and surface water, data was collected during the groundwater investigation and included groundwater quality measurements, groundwater and seasonal drainage area surface water level measurements, and groundwater chemical concentrations (explosives including NG), perchlorate, Target Analyte List (TAL) total metals, VOCs, SVOCs including low-level PAHs, pesticides, PCBs, EPH, and VPH. Groundwater results are documented in the Technical Memorandum Groundwater Report provided in Appendix C (Tetra Tech, 2014). COPC concentrations are not expected to change significantly in groundwater based on evaluation of the two rounds of groundwater data collected to date; however, groundwater levels and the size of seasonal drainage areas do fluctuate seasonally. Also during the groundwater investigation, geologic features of the Quarry Area that affect groundwater flow were identified, including field investigation and mapping of strike and dip measurements of bedrock fractures (e.g., foliation and joints) and information on fracture spacing and coatings and documented in the August 2012 Bedrock Fracture Trace Analysis Report provided in Appendix F (Tetra Tech, 2012b).

Target Analytical Groups: Laboratory-analyzed chemical data are needed to determine contaminant concentrations in surface soil, subsurface soil, sediment, and surface water. To obtain data of sufficient quality for risk assessment, all of the data collected for the MC RI will be analyzed via off-site laboratories. Where an area of landfilled material is encountered [e.g., drum, staining, elevated photoionization detector (PID) reading] or suspected based on site history, or where a potential hazardous source item of concern is encountered beyond the landfilled area (e.g., unmarked drum on the ground surface), a full suite of analytical groups is warranted, including VOCs, SVOCs including low-level PAHs, pesticides, PCBs, EPH, VPH, explosives including NG, and TAL metals (including 10% of the samples also analyzed for hexavalent chromium, 031303/P

Revision: 1

Date: September 2014 Worksheet 11

Page 47 of 178

pH, and oxidation reduction potential [ORP] to aid reducing risk assessment uncertainty). Similarly, where landfarming soils are suspected or

encountered, residual petroleum contamination could include analytes from any of the analytical groups. Where only munitions sources are

encountered (e.g., breached munition) or suspected (kickout area beyond the waste disposal area), explosives including NG and TAL metals

(including 10% of the samples also analyzed for hexavalent chromium, pH, and ORP) are adequate. Although non-munitions-related solid waste

was found within the guarried area during the 2010 Exploratory MEC Investigation, significant contamination from non-munitions debris is not

expected based on the types of construction debris (reinforced concrete, scrap metal, wire, etc.) encountered. However, the presence or absence

of non-munitions-related waste contamination needs to be confirmed. Radiological debris is not expected but is possible because landfilling

activities occurred. This portion of the investigation is being completed by Tetra Tech EC in accordance with a separate SAP and so is not

detailed herein.

Items of environmental concern discovered by USA during the MEC portion of the investigation will be investigated by Tetra Tech NUS personnel,

and a biased soil sample will be collected within the contaminant release area associated with the item. For lithology purposes, where disposal is

suspected, the intended depth of the investigation is to undisturbed soil or bedrock. Also, although the groundwater investigation was adequate in

establishing site lithology for natural conditions, refinements in depths to bedrock at select locations will improve the cost estimates for the future

(FS).

Physical Data: Physical data are needed to support the site evaluation. Lithology data are needed to characterize soil, sediment, and depths to

bedrock throughout the site due to the complex site history that includes quarrying, use of the site as a borrow pit, landfilling, and landfarming

events. Information is needed to determine depths to natural material and depths to bedrock at the select locations described in Worksheet #17.

Surface water quality data including specific conductance, temperature, pH, turbidity, ORP, and dissolved oxygen will also be collected. Eh for

surface water will be calculated based on addition of an offset voltage for ORP field measurements.

Sampling Techniques: A combination of the following sampling techniques will be needed in the field:

CTO 69 031303/P

Revision: 1

Date: September 2014 Worksheet 11

Page 48 of 178

Soil:

Mechanical excavation (by USA) for intrusive investigation of anomalies and for investigation of depths to natural material.

Direct-push technology (DPT) drilling where an undisturbed vertical profile of lithology is needed. Also, if mechanical excavation at a given

location is unsuccessful in determining the depth to natural material, DPT drilling will be used as a contingency.

Hand augering where proposed sampling is less than 1 foot bgs or where DPT rig access is limited and proposed sampling is less than 3 feet

bgs.

Sediment:

• Hand augering is an adequate method to obtain the shallow samples needed for sediment, where the vertical boundary is 1 foot bgs; 0 to

6 inches below the sediment surface is the sediment interval associated with ecological exposure for the ERA and 6 inches to 1 foot will

provide information on sediment thickness and depth of potential contamination; for the HHRA, the interval of interest for exposure is 0 to

1 foot bgs.

Surface Water:

• Grab surface water samples will be collected via the direct dip or weighted bottle sampling method. Samples will be collected from just

beneath the water surface.

Sample Location Data: Measurement of horizontal coordinates using a global positioning system (GPS) unit with sub-meter accuracy (or better)

provides sufficient accuracy and precision. Coordinates must be determined at each sampling location, and analytical data must be plotted

spatially at each sample location. Field observations and digital photographic records are needed of sampling locations, and soil boring logs and

trench excavation logs are also required. Recording of any munitions/non-munitions items encountered is the responsibility of USA.

Worksheet #17 contains detailed information on the types of data needed for this project, including proposed sample locations and sampling

rationale, and Worksheet #19 lists required analytical methods. Sampling techniques are described in Worksheet #14, and Worksheet #15 details

the laboratory analytical LOQs, LODs, and DLs for all chemicals.

Revision: 1

Date: September 2014 Worksheet 11

Page 49 of 178

HOW "GOOD" DO THE DATA NEED TO BE IN ORDER TO SUPPORT THE ENVIRONMENTAL DECISION?

The laboratory data need to be of sufficient quality to answer the environmental questions with sufficient confidence that risk management and

remedial decisions can be made. Details of how the quality of the data will be ensured and assessed are included in Worksheet #37. The QA/QC

will be performed on all laboratory results. Detailed QA/QC data requirements are presented in Worksheet #20. Data validation requirements are

detailed in Worksheet #36.

The laboratory will follow the measurement performance criteria (MPCs) in Worksheet #28 for laboratory QC samples. These MPCs are

consistent with the DoD Quality Systems Manual (QSM) (DoD, 2010), as applicable, and with laboratory in-house limits where the QSM does not

apply. Field QC MPCs are described in Worksheet #12.

HOW MUCH DATA SHOULD BE COLLECTED (NUMBER OF SAMPLES FOR EACH ANALYTICAL GROUP, MATRIX, AND

CONCENTRATION)?

The data will be concluded to be of sufficient type, number, and quality if the scheduled samples are collected and analyzed and the data satisfy

the data validation criteria and usability assessment requirements. In general, this requires that the data be representative of the targeted media

population, that the data be generated by sufficiently sensitive analytical methods that are operating within QC limits, and that the data are

considered comparable in terms of quality and representativeness. Detailed information on how much data will be collected is provided in

Worksheet #s 17 and 18. Numbers of QA/QC samples for each chemical analysis are discussed in Worksheet #20.

WHERE, WHEN, AND HOW SHOULD THE DATA BE COLLECTED/GENERATED?

Where?

The project data will be collected at the Quarry Area at former NAS Brunswick in Brunswick, Maine. Detailed information on where the data will be

collected is provided in Worksheet #17, which includes sample location maps and sample collection decision tree matrices. DUs were established

to aid the development of the sampling strategy. These DUs served to establish where data should be collected. After review of the collected

Revision: 1

Date: September 2014 Worksheet 11

Page 50 of 178

data, the project team will select EUs for which risks must be evaluated. The EUs will take into consideration the contamination patterns, receptor

behavior, and other factors that facilitate an assessment of the risks for various receptors.

When?

The schedule for the Tetra Tech NUS lithology/chemical sampling investigation, along with the USA MEC investigation and Tetra Tech EC

radiological investigation, is included on Worksheet #16. All data will be collected during the period of field operations after a single mobilization to

perform the RI. If USA Environmental drains any of the surface water bodies to facilitate the MEC investigation, Tetra needs to sample for surface

water beforehand, in an undisturbed state, and for sediment afterwards.

How?

Detailed information on how the data will be collected is provided in Worksheet #s 14 and 17. Data will be collected in accordance with the SOPs

appended to this SAP and summarized in Worksheet #s 21 and 23, field and analytical laboratory SOPs, respectively.

WHO WILL COLLECT AND GENERATE THE DATA?

The Tetra Tech NUS team will generate all field data associated with the lithology and chemical sampling investigation. Additional information on

project personnel is provided in Worksheet #s 5 and 7. The samples will either be delivered by overnight courier to the analytical laboratories,

Katahdin, Microbac, and ALS (under subcontract to Tetra Tech NUS), or picked up onsite by Katahdin. Analytical data generated by Katahdin,

Microbac, and ALS will be submitted to Tetra Tech NUS. Once received, data will be reviewed and validated by Tetra Tech NUS and uploaded

into the Naval Installation Restoration Information Solution (NIRIS), a centralized electronic database used for Navy projects.

Electronic mapping will be shared among USA, Tetra Tech NUS, and Tetra Tech EC.

HOW WILL THE DATA BE REPORTED?

During the field effort, Tetra Tech NUS will provide USA with input for preparation of weekly e-mail update and written daily field reports.

031303/P

CTO 69

Revision: 1

Date: September 2014 Worksheet 11

Page 51 of 178

An RI Report will be generated by Tetra Tech NUS documenting the soil, sediment, surface water, and groundwater results and including field

data, validated laboratory results, tag maps, human health and ecological risk assessment results and conclusions/recommendations. Separate

reports will be prepared by the other contractors for their investigations; text will be shared among USA, Tetra Tech NUS, and Tetra Tech EC to

aid in report generation and consistency.

HOW WILL THE DATA BE ARCHIVED?

Hard copy reports will be stored in the appropriate project files at NAVFAC Midlant and in the Administrative Record repository. Digital versions of

the RI SAP and RI Report will be electronically transferred into the NIRIS Electronic Data Deliverables (NEDD)/NIRIS.

PQOS LISTED IN THE FORM OF IF/THEN QUALITATIVE AND QUANTITATIVE STATEMENTS.

Due to the presence of MEC/MPPEH at the Quarry Area, an FS has already been recommended in the Draft Munition and Explosive of Concern

Investigation Report (Tetra Tech, 2013) to evaluate remedial options for munitions-related hazards. The decision rules developed for the Quarry

Area Soil/Sediment/Surface Water RI are as follows (also refer to the separate SAPs concerning MEC investigation and radiological screening and

testing):

1. If, following the evaluation of the Soil/Sediment/Surface Water RI data, the Project Team identifies data gaps that prevent characterization of

nature and extent of contamination, convene the Project Team to determine how to address the data gaps; otherwise, proceed to risk

assessment as per decision rules 2 and 3 (or proceed to interim measures [IM] if warranted by elevated concentrations several orders of

magnitude greater than screening criteria) for chemical contamination.

At a minimum, this evaluation will consider the following factors relative to the existing CSM for each environmental medium:

Frequency of detection for each constituent

Frequency and magnitude of PSL exceedance for each constituent

Background concentrations of metals and PAHs (soil and groundwater) and pesticides (soil only) that exceed PSLs

Revision: 1

Date: September 2014 Worksheet 11

Page 52 of 178

- Magnitude of concentrations
- Spatial trends of each contaminant
- Whether an IM would be cost-effective and protective of human health and the environment.
- 2. <u>HHRA</u> If human health risks associated with potential exposures to any medium exceed an Incremental Lifetime Cancer Risk (ILCR) of 1E-5 or a Hazard Index (HI) of 1 for a target organ or critical effect for the future hypothetical lifelong resident exposure scenario (as evaluated in accordance with the methodology in Appendix D) in a given EU, or if the USEPA target blood-lead concentration is exceeded and the associated background concentration is exceeded (with consideration given to applicable background metals, PAHs, and pesticides), then convene the Project Team to evaluate potential options for risk reduction during an FS for that EU for both chemical and MEC/MPPEH risks; otherwise, recommend no further action for chemical constituents affecting human receptors based on the HHRA but still proceed to an FS for MEC/MPPEH.

Note: If a contaminant concentration exceeds the associated soil, sediment, or surface water PSL listed in Worksheet #15 or groundwater PSL listed in Appendix B but is less than an associated background value for soil and groundwater, that chemical will not be selected as a COPC in accordance with the HHRA provided in Appendix D.

3. <u>ERA</u> - If the ERA conducted based on the methodology presented in Appendix E indicates that risks to plants, soil invertebrates, sediment invertebrates, aquatic organisms, mammals or birds are unacceptable in any EU and if background concentrations are exceeded in the same EU for chemicals contributing significantly to the estimated risks, then convene the Project Team to evaluate potential options for risk reduction during an FS for that EU for both chemical and MEC/MPPEH risks; otherwise, recommend no further action for protection of the environment from chemical constituents but still proceed to an FS for MEC/MPPEH.

Lead will be evaluated using the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in Children, Windows Version 1.1, Build 11 (2010). Exposure of adults (workers and recreational users) to lead will be evaluated by the adult exposure model [USEPA Technical Review Workgroup (TRW) for Metals and Asbestos] (2003c). The results of IEUBK modeling are in terms of the probability that exposed children will exceed a 10 microgram per deciliter (μg/dL) blood-lead level, and the output of the USEPA TRW model is the probability that elevated fetal blood-lead concentrations (i.e., concentrations greater than 10 μg/dL) will result due to exposures of women of childbearing age. Those probabilities are compared to the USEPA goal of limiting the probability of exceeding a 10 μg/dL blood-lead concentration to 5 percent.

Date: September 2014 Worksheet 12 Page 53 of 178

SAP Worksheet #12 -- Measurement Performance Criteria Table -- Field Quality Control Samples

(UFP-QAPP Manual Section 2.6.2)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPCs)	QC Sample Assesses Error for Sampling (S), Analytical (A) or Both (S&A)	
Trip Blank	VOCs only	One per cooler containing VOC samples	Bias/ Contamination	No analytes ≥ ½ LOQ (>LOQ for common laboratory contaminants), except common laboratory contaminants, which must be < LOQ.	S & A	
Equipment Rinsate Blank	All analytical groups included in the associated samples (explosives including propellant NG and perchlorate, TAL metals, including hexavalent chromium, and as applicable VOCs, SVOCs, PCBs, pesticides, VPH, EPH)	One per 20 field samples per sampling equipment ⁽¹⁾	Bias/ Contamination	No analytes ≥ ½ LOQ (>LOQ for common laboratory contaminants), except common laboratory contaminants, which must be < LOQ.	S & A	
Field Duplicate	All analytical groups for the original sample (explosives including propellant NG and perchlorate, TAL metals including hexavalent chromium, pH, and ORP and as applicable VOCs, SVOCs, PCBs, pesticides, VPH, EPH)	One per 20 discrete field samples collected	Precision	Relative percent difference (RPD) must be ≤ 30% for aqueous samples and ≤ 50% for soil samples. If sample results are < two times the LOQ, professional judgment is used. (2, 3)	S & A	
Cooler Temperature Indicator	All analytical groups	One per cooler	Representative- ness	Temperature must be between 0 and 6 degrees Celsius (°C), but samples must not be frozen.	S	

¹ Equipment rinsate blanks will be collected for non-dedicated sampling equipment. For disposable equipment, one sample per batch of disposable equipment will be collected.

² If duplicate values for non-metals are less than five times the LOQ, the absolute difference should be less than or equal to two times the LOQ.

³ If duplicate values for metals are less than five times the LOQ, the absolute difference should be less than or equal to four times the LOQ.

SAP Worksheet #13 -- Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title, and date)	How Data Will Be Used	Limitations on Data Use		
MEC Investigation	Site Inspection Report (2009)	Tetra Tech; visual and geophysical observations of MEC/MPPEH, 2008/2009	To help guide survey/sample placement	No limitations are identified for data use.	
Bedrock Fracture Trace Analysis	Bedrock Fracture Trace Analysis Report (2012)			No limitations are identified for data use.	
Groundwater Investigation	Draft Technical Memorandum Groundwater Report (in review, March 2014)	Tetra Tech, lithology, groundwater flow directions, and groundwater analysis, August through October 2012 and November through December 2013	Results will be evaluated in Quarry RI Report.	No limitations are identified for data use.	
MEC Investigation	Draft MEC Investigation Report (in Navy review, 2013)	Tetra Tech; surface and subsurface MEC investigation and surface clearance, 2010 through 2012.	To help guide survey/sample placement	No limitations are identified for data use.	
Expanded MEC Investigation	Expanded MEC investigation (pending report, key information and results provided by USA via e-mail)	USA	To help guide sample placement	No limitations area identified for data use.	

Revision: 1

Date: September 2014 Worksheet 14

Page 55 of 178

SAP Worksheet #14 -- Summary of Project Tasks

14.1 FIELD INVESTIGATION TASK PLAN

Site-specific SOPs have been developed for field activities at former NAS Brunswick and are included in

Appendix G. The following field tasks will be completed by Tetra Tech NUS during the subject

soil/sediment RI, unless noted otherwise:

Mobilization/demobilization.

Utility clearance (conducted by USA under a separate plan).

Site-specific health and safety training.

Monitoring equipment calibration.

UXO Anomaly Avoidance.

Sample collection.

Surface and subsurface soil discrete sampling (mechanical excavation conducted by USA; hand

augering, DPT drilling, and all chemical sampling conducted by Tetra Tech NUS).

RAD screening and sampling (conducted by Tetra Tech EC).

Sediment and surface water sampling.

GPS locating of soil boring and sediment/surface water sample locations and site features.

Investigation-derived waste (IDW) management.

Field decontamination procedures.

Field documentation procedures.

Sample handling.

QC.

The subsections below describe on those tasks being completed by Tetra Tech NUS.

Mobilization/Demobilization

Mobilization will consist of the delivery of all equipment, materials, and supplies to the site, complete

assembly in satisfactory working order of all such equipment at the site, and satisfactory storage at the

site of all such materials and supplies. The Tetra Tech NUS FOL or designee will coordinate with the

USA Senior UXO Supervisor (SUXOS) to identify appropriate locations for the storage of equipment and

supplies. Stakeholders (USEPA and MEDEP) will be notified by the Tetra Tech NUS PM at least 2 weeks

prior to mobilization of the name of the drilling subcontractor to be used for this project.

Revision: 1

Date: September 2014 Worksheet 14

Page 56 of 178

Demobilization will consist of the prompt and timely removal of all equipment, materials, and supplies

from the site following completion of the work. Demobilization includes the cleanup and removal of waste

generated during the performance of the investigation.

Site-Specific Health and Safety Training

Project-specific safety requirements will be addressed in detail in the site-specific HASP/APP to be

prepared by Tetra Tech NUS and submitted to the Navy to address in further detail safety requirements

concerning soil and sediment sampling and lithology determination via hand augering and DPT drilling

and surface water sampling via direct dip method. Otherwise, health and safety measures will be

conducted in accordance with the USA HASP/APP, particularly concerning munitions and mechanical

excavation. All field personnel will review and be familiar with the HASP/APPs, and copies will be

maintained on site. A site-specific health and safety meeting as described in Worksheet #8 will be

conducted on site prior to initiating field activities, which all subcontractor personnel (including substitutes)

are required to attend. A PID will be used as the field instrument for health and safety monitoring during

soil and sediment sampling.

Monitoring Equipment Calibration

Field equipment (PID) will be calibrated in accordance with manufacturers' guidance by the Tetra Tech

NUS FOL or designee. Documentation of field equipment calibration is required. Field equipment will be

calibrated at the beginning and end of each day, unless otherwise stated by the equipment manufacturer.

Monitoring equipment calibration procedures are described in Worksheet #22.

Sample Collection

All sample collection tasks will be preceded by UXO anomaly avoidance conducted by a qualified UXO

Technician. The Tetra Tech NUS sampling and analysis program is outlined in Worksheet #18 and

shown on Figure 17-1 in Worksheet #17. Sample collection will be in accordance with the SOPs listed in

Worksheet #21 and provided in Appendix G. Hand augering and DPT drilling for sampling and lithology

determination will be conducted by Tetra Tech NUS, and mechanical excavation will be conducted by

USA. All chemical sampling will be conducted by Tetra Tech NUS. The field team will collect VOC and

VPH data as soon as possible after MEC and radiological screening. The sampling requirements for

each type of analysis (i.e., bottleware, preservation, and holding times) are listed in Worksheet #19. Field

and laboratory QC samples will also be collected as outlined in Worksheet #20.

Revision: 1 Date: September 2014 Worksheet 14

Worksheet 14 Page 57 of 178

Surface and Subsurface Soil Discrete Sampling - DU1, DU2, DU3, and DU4

The methodologies for soil sampling for lithology determination and sample collection will be hand augering, DPT drilling, or mechanical excavation, based on the objectives developed in Worksheet #11 and identified in detail in Table 17-1. Note that excavations will not extend below the water table. Figure 17-2 shows all locations where known lithology determination and/or sampling activity is to occur; Figure 17-1 shows a more expansive view that incorporates all MEC investigation activity. Contingency samples are reserved for collection as warranted across the site based on visual or olfactory observations that indicate potential contamination. The FOL will confer with the Tetra Tech NUS PM prior to installing contingency borings or collecting contingency samples. A contingency sample may be collected as an extra sample at a planned soil boring or excavated trench, or in the event that a contaminant source item of concern is unearthed at a hand dig location based on field observations during MEC investigation via transects. All samples will be collected from the excavated material after it has been deposited on the ground and cleared of MEC/MPPEH and after radiological screening has been completed. Refer to SOP SA-1.3 (Soil Sampling, Appendix G).

Discrete surface soil samples will be collected from 0 to 1 foot bgs, and discrete subsurface soil samples will be collected from 2-foot intervals at the depths specified in Table 17-1. All samples will be analyzed for MC constituents consisting of explosives including NG, and TAL metals (including 10% of samples also analyzed for hexavalent chromium, pH, and ORP). As warranted, samples will additionally be analyzed for VOCs, SVOCs, EPH/VPH, pesticides, and PCBs. Select borings will be advanced to bedrock so that the complex subsurface lithology related to quarrying activities can be clarified. Where samples are to be collected from a potential point source such as a drum or where field observations indicate staining or elevated PID readings, the sample should be collected as close to the source item as possible.

Discrete soil samples for chemical analysis will be collected, in accordance with Tetra Tech NUS SOP SA-1.3 (Soil Sampling, Appendix G). Each soil sample will be described by the Tetra Tech NUS field representative in accordance with Tetra Tech NUS SOP GH-1.5 (Borehole and Sample Logging, Appendix G). Samples will be homogenized, decanted if necessary (if wet), and transferred into appropriate bottleware using disposable trowels. At the select locations where VOCs are to be collected, the VOC fraction of the sample will be taken out of the first core collected, and then additional cores will be collected as needed until there is sufficient sample volume for the remaining fractions. One sample log sheet will be completed for each soil sample collected. Each soil boring log and trench excavation log will note the soil type, color, lithology, and mineral content of coarse-grained material present, sample intervals, organic vapor field screening measurements, and a qualitative indication of soil conditions. For

Revision: 1
Date: September 2014

Worksheet 14 Page 58 of 178

each hand auger or DPT boring, the entire length of each boring will be logged using the Unified Soil Classification System (USCS) and screened for organic vapors using a PID. Due to MEC concerns, Tetra Tech NUS personnel will be unable to log the trench excavations in real time; therefore, close coordination with the MEC team (USA) will be necessary to estimate the original location of the excavated soil selected for sampling and to conduct the work in lifts to minimize mixing of the vertical profile. A field sketch and photographs of the excavated soil and sidewalls/bottom of each excavated trench will be generated. As applicable and if distinguishable, approximated field observations for the trenches, including depths to groundwater, depths to bedrock, depths of lithology change(s), and depths to natural materials, will be recorded. Any qualitative visual signs of potential contamination (e.g., soil staining, elevated PID readings, or odors) will be noted on soil sample log sheets and boring/trench logs.

Concerning IDW, the nominal excess soil expected to be generated from hand augering will be placed back into the boring from which it was removed rather than containerized. Drill cuttings from DPT soil borings and trenching will be returned to the original locations as backfill. IDW generated from decontamination of equipment (SOP SA-7.1 Decontamination of Field Equipment, Appendix G) will be containerized and managed as IDW as discussed below.

Sediment and Surface Water Sampling - DU5

The discrete surface sediment sampling and grab surface water sampling locations in DU5 are in three seasonal drainage areas, in an area extending along the base of the quarry rock face, at the western surface water drainage near Route 123, and at Significant Vernal Pool #42 located south of Old Route 24. Because the swales along the base of the quarry rock face only have shallow standing water intermittently and for the other two drainage areas, if necessary, surface water may be drained to allow MEC investigation, if this is the case, surface water samples will be collected before these areas are drained, in an undisturbed state, and sediment samples will be collected after these areas are drained. Sediment samples are expected to be collected using a hand auger, and grab surface water samples will be collected via the direct dip or weighted bottle method from just beneath the water surface. Sediment and surface water samples will be collected following SOP SA-1.2 (Surface Water and Sediment Sampling, Appendix G). Sediment sample materials will be collected from two depth intervals (0-to 6-inch and 6- to12-inch intervals) below the sediment surface at each location. All sediment samples will be analyzed for explosives including NG, TAL metals (including 10% of samples also analyzed for hexavalent chromium, pH, and ORP) SVOCs, EPH/VPH, pesticides, and PCBs and also VOCs at select locations. At the select locations where sediment samples will be collected for VOC analysis, the VOC fraction of the sample will be taken out of the first core collected and then additional cores will be collected as needed until there is sufficient sample volume for the remaining fractions. Sediment samples

Revision: 1

Date: September 2014

Worksheet 14 Page 59 of 178

will be homogenized, decanted if necessary, and transferred into appropriate bottleware. One sample log

sheet will be completed for each sediment and surface water sample collected (in accordance with

SOP SA-1.2 Surface Water and Sediment Sampling included in Appendix G). Surface water samples will

be analyzed for explosives including NG and perchlorate, TAL metals (including 10% of samples also

analyzed for hexavalent chromium), VOCs SVOCs, EPH/VPH, pesticides, and PCBs. Surface water

quality data including specific conductance, temperature, pH, turbidity, ORP, and dissolved oxygen will

also be collected in accordance with SOP SA 1.1 Groundwater Sample Acquisition and Onsite Water

Quality Testing. The field water quality meters measure ORP relative to silver/silver chloride reference.

To calculate Eh from field measurements of ORP, an offset voltage of +199 millivolts will be added to the

field measured ORP voltage.

GPS Locating

A hand-held Trimble GPS or equivalent unit will be used to locate all discrete soil and sediment/surface

water sampling points in accordance with MRP SOP 05 (Data Collection and Transfer, Appendix G). For

trench locations, the GPS will be used to record each corner of the completed trench, and each sample

location within the trench will be approximated via tape measure and field sketch. GPS instruments will

be checked at the start of each day and again at the end of each day by direct comparison to known

survey monuments. Positional accuracy will be within the manufacturer's stated tolerance of the

instrument; a sub-foot accuracy instrument will be acceptable if its positional accuracy is within 1 foot of

the reference point. The reference points may be survey monuments, survey markers, and/or permanent

monitoring wells). Positional Dilution of Precision (PDOP) Criteria of three or less will be established prior

to collecting positional data. Results of the instrument checks will be reviewed for accuracy and

repeatability and archived by the Tetra Tech NUS FOL. If abnormalities are discovered, corrections will

be made and the process will be repeated. If the PDOP and number of satellites are not adequate to

collect high-quality results, a tape measure and compass may be used to measure locations from a

surveyed point.

IDW Management

Solid IDW (soil) will be generated during advancement of soil borings and trench excavation. Excess soil

cuttings that were not collected for laboratory analyses are expected to be limited and will be placed back

in the boring from which they were generated, unless field observations such as staining, PID readings,

etc. suggest that select cuttings should be containerized and sampled. Aqueous IDW will be generated

during decontamination procedures.

Revision: 1 Date: September 2014

Worksheet 14 Page 60 of 178

All IDW generated will be containerized in Department of Transportation (DOT)-approved (specification 17C) 55-gallon drums and stored in the centralized location near the investigation area during Quarry Area MC RI field activities. The drums will be labeled as soon as possible after they are filled and will be arranged into rows by the drilling subcontractor (no more than two drums deep) segregated by liquids, solids, and contaminated personal protective equipment (PPE) for easy access. IDW associated with containerized drill cuttings will be analyzed for Toxicity Characteristic Leaching Procedure (TCLP) organics and inorganics, and other waste characterization parameters as required by the disposal facility, to determine disposal requirements. All aqueous IDW will be containerized pending waste characterization analyses for the same analytical suite as the soil samples. Drums will be cleaned prior to moving them to the centralized storage area and stored on pallets. Based on the results of waste characterization analyses, the IDW will be transported and appropriately disposed of off-site at a Navyapproved disposal facility.

Field Decontamination Procedures

Decontamination of sampling equipment will not be necessary for dedicated and disposable sampling equipment. Decontamination of reusable sampling equipment (non-disposable hand trowels, hand augers, etc.) will be conducted prior to sampling and between samples at each location. Decontamination fluids will be managed, containerized, and characterized for appropriate disposal with other IDW. Decontamination of large equipment, including the DPT rig and excavator bucket, will be conducted according to the sequence established in SOP SA-7.1 (Decontamination of Field Equipment, Appendix G). Tetra Tech NUS will be responsible for decontamination of sampling equipment and will oversee decontamination of the DPT rig by the DPT subcontractor. A decontamination pad will be constructed at the center of the site for this purpose. Although USA is responsible for excavation, Tetra Tech NUS will be responsible for decontamination of the excavator bucket. To minimize decontamination water generation, the bucket will be cleaned as much as possible to remove soil before pressure washing, and pressure washing will be conducted only to the extent necessary. The decontamination pad constructed by the DPT driller will be used by Tetra Tech NUS for decontamination of the excavator bucket.

Field Documentation Procedures

To ensure detailed and accurate documentation of field activities, which is necessary to ensure data integrity, authenticity, and defensibility, Tetra Tech NUS SOP SA-6.3 (Field documentation, Appendix G) for sample documentation, handling, tracking, and custody will be followed.

Revision: 1

Date: September 2014

Worksheet 14 Page 61 of 178

Field sampling log sheets will be organized by date and medium and filed in the project files. The field

logbooks for this project will be used only for this site and will also be categorized and maintained in the

project files after completion of the field program. Project personnel completing concurrent field sampling

activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling

activity. The field logbooks will be titled based on date and activity.

Sample Handling

After samples have been collected, they will be held on ice and sent to the appropriate analytical

laboratory within a reasonable time depending on the holding times for the associated analytes. The

shipment of samples to the laboratories will be made via an overnight shipping courier service

(e.g., FedEx) following SOP SA-6.1 (Non-Radiological Sample Handling, Appendix G). Sample

containers will be provided certified clean (I-Chem 300 or equivalent) from the analytical laboratory.

Sample labeling will be in accordance with Worksheet #14, and the sample numbering scheme will be in

accordance with Worksheet #18. The selection of sample containers and sample preservation,

packaging, and shipping will be in accordance with Worksheet #19 and SOP SA-6.1 (Non-Radiological

Sample Handling) and SOP CT-4.0 (Sample Nomenclature) (Appendix G).

Quality Control Tasks

QA/QC samples will be collected at frequencies listed in Worksheet #12.

14.2 ANALYTICAL AND REPORTING PROJECT TASKS

Additional project-related tasks include the following:

Analytical tasks

Data generation procedures

Data management

Assessment and oversight

Data review

Project Reports

Analytical Tasks

Chemical analyses for explosives, VOCs, SVOCs, PCBs, pesticides, EPH/VPH, and TAL metals will be

performed by Katahdin Analytical Services, Scarborough, Maine, which is a DoD Environmental

Revision: 1

Date: September 2014

Worksheet 14 Page 62 of 178

Laboratory Approval Program (ELAP)-accredited laboratory for the target analytes and analytical groups

that will be reported by them. Chemical analysis for perchlorate will be performed by Microbac

Laboratories, Inc., Marietta, Ohio, which is a DoD ELAP-accredited laboratory for the target analyte that

will be reported by them. Chemical analysis for hexavalent chromium all media, and pH and ORP for soil

samples only, will be performed by ALS Environmental-Rochester, Rochester, New York, which is a DoD

ELAP-accredited laboratory for the target analytes and analytical groups that will be reported by them.

Katahdin and ALS are also Maine-accredited laboratories. Analyses will be performed in accordance with

the analytical methods identified in Worksheet #30. Katahdin, Microbac, and ALS will perform the

chemical analyses following laboratory-specific SOPs (see Worksheet #s 19 and 23) developed based on

the methods listed in Worksheet #s 19 and 30.

The Katahdin, Microbac, and ALS QAMs will ensure that all laboratory SOPs were followed and will verify

that all method QC samples were analyzed and in control, as listed in the analytical SOPs. If method QC

is not in control, the Katahdin, Microbac, and ALS QAMs, as appropriate, will contact the Tetra Tech NUS

PM for guidance in real time as problems arise. Results will be reported in each analytical data package

and electronic data deliverable (EDD). This information will also be included in the project database that

will eventually be uploaded to NIRIS. In addition, data will be supplied to MEDEP in the approved data

format.

All soil and sediment results will be reported by the laboratory on an adjusted dry-weight basis. Percent

moisture results will be reported in each analytical data package and associated electronic data files.

This information will also be added to the project database, which will eventually be uploaded to NIRIS.

Percent moisture information will also be included in the RI Report.

The analytical data packages provided by Katahdin, Microbac, and ALS will be in a Contract Laboratory

Program (CLP)-like format, will be fully validatable, and will contain raw data, summary forms for all

sample and laboratory method blank data, and summary forms containing all method-specific QC

information [results, percent recoveries (%Rs), RPDs, Relative Standard Deviations (RSDs), and/or

percent differences or percent drifts (%Ds), etc.].

Data Generation Procedures

Project documentation and records will include the following:

• Field sample collection and field measurement records as described in Worksheet #s 27 and 29.

Data assessment documents and records as listed in Worksheet #29.

Revision: 1

Date: September 2014 Worksheet 14

Page 63 of 178

Data recording formats are described in Worksheet #27.

Data Handling and Management

Data management tasks, including data handling, tracking, storage, archiving, retrieval, and security

processes, are addressed in Worksheet #29.

The principal data generated for this project will be field and laboratory analytical data. After the RI is

completed, field sampling log sheets will be organized by date and medium and filed in the project files.

The field logbooks for this project will be used only for this site and will also be categorized and

maintained in the project files after the completion of the field program. Project personnel completing

concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be

segregated by sampling activity. The field logbooks will be titled based on date and activity.

The data handling procedures to be followed by the laboratory will meet the requirements of the technical

specifications. Electronic data results will be automatically downloaded into the Tetra Tech NUS

database in accordance with proprietary Tetra Tech NUS processes.

The Tetra Tech NUS PM (or designee) is responsible for the overall tracking and control of data

generated for the project, which includes the following:

Data Tracking. Data are tracked from generation to archiving in the Tetra Tech NUS project-specific

files. The Tetra Tech NUS Project Chemist (or designee) is responsible for tracking the samples

collected and shipped to the laboratories. Upon receipt of the data packages from the laboratories,

the Tetra Tech NUS Project Chemist will oversee the data validation effort, which will include verifying

that the data packages are complete and that results for all samples have been delivered by the

laboratories.

Data Storage, Archiving, and Retrieval. The data packages received from the laboratories are

tracked in the data validation logbook. After the data are validated, the data packages are entered

into the Tetra Tech NUS Navy CLEAN file system and archived in secure files. Field records

including field logbooks, sample log sheets, chain-of-custody records, and field calibration logs will be

submitted by the Tetra Tech NUS FOL to be entered into the Navy CLEAN file system prior to

archiving in secure project files. The project files are audited for accuracy and completeness. At the

Revision: 1

Date: September 2014 Worksheet 14 Page 64 of 178

completion of the Navy contract, the records will be stored by Tetra Tech NUS. Electronic data will

be uploaded to NIRIS as indicated in Worksheet #29.

Data Security. Access to Tetra Tech NUS project files is restricted to designated personnel only.

Records can only be borrowed temporarily from the project file using a sign-out system. The Tetra

Tech NUS Data Manager maintains the electronic data files, and access to the data files is restricted

to qualified personnel only. File and data backup procedures are routinely performed.

• Electronic Data. All electronic data will be compiled into a NEDD and loaded into NIRIS.

Assessment and Oversight

Refer to Worksheet #32 for assessment findings and CAs and to Worksheet #33 for QA Management

Reports.

Data Review

Data verification is described in Worksheet #34, data validation is described in Worksheet #s 35 and 36,

and usability assessment is described in Worksheet #37.

Project Report

A preliminary draft RI report will be prepared for Navy review. Subsequently, draft and final versions of

the project report will be prepared and submitted to USEPA and MEDEP for review. The report will

include the following sections:

Executive Summary – will include a brief description of the work conducted and the findings.

Introduction and Background – will include a description of the history of operations and activities at

the site and a summary of previous investigations and removal actions.

Description of Field Investigations – will include a summary of the work performed in accordance with

this approved Uniform Federal Policy (UFP)-Sampling and Analysis Plan (SAP) and any field

modifications as documented by the Tetra Tech NUS FOL. This section will include maps showing

sampling locations and tables summarizing the data collected.

Revision: 1

Date: September 2014

Worksheet 14 Page 65 of 178

• Data Quality - will include a summary of quantitative analytical performance indicators such as

completeness, precision, bias, and sensitivity as well as qualitative indicators such as

representativeness and comparability. This section will include a reconciliation of project data with

the DQOs and an identification of deviations from this UFP-SAP.

A data usability assessment will be used to identify significant deviations in analytical performance

that could affect the ability to meet project objectives. The elements of this review are presented in

Worksheet #37.

Nature and Extent of Contamination – will include a discussion of the contamination identified in each

medium sampled in relation to the CSM of the site. Detected contaminant concentrations will be

tabulated for each medium and depicted on maps.

Contaminant Fate and Transport – will include a description of the contaminants detected and their

behavior in the soil, bedrock, sediment, surface water, and groundwater, with particular emphasis on

the future migration of these contaminants to any possible exposure areas.

Ecological and Human Health Risk Assessments will be prepared in accordance with methodologies

presented in Appendices D and E, respectively, and will include a discussion of the risks to human

and ecological receptors for all identified COCs.

Summary and Conclusions – will include a summary of the findings, conclusions assessing whether

delineation of contamination is adequate, and a recommendation for further investigations if needed.

Tetra Tech NUS will submit the draft report and respond to comments received on the draft report. The

final version of the report will submitted in hardcopy and electronic format to the project stakeholders.

SAP Worksheet #15a -- Reference Limits and Evaluation Table - Soil

Project screening-level support documentation is provided in Appendix B.

(UFP-QAPP Manual Section 2.8.1)

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
TARGET ANALYTE LIST METALS										
ALUMINUM**	7429-90-5	7700	EPA RSL	50	ORNL Plant	50	16.7	30	4	0.51
ANTIMONY**	7440-36-0	3.1	EPA RSL	0.27	EPA SSL Wildlife	0.27	0.09	0.1	0.05	0.02
ARSENIC**	7440-38-2	0.67	EPA RSL	17	CCME Plant/Invert.	0.67	0.22	0.5	0.4	0.15
BARIUM**	7440-39-3	1500	EPA RSL	330	EPA SSL Invert	330	110	0.2	0.1	0.037
BERYLLIUM**	7440-41-7	16	EPA RSL	10	ORNL Plant	10	3.3	0.1	0.02	0.0041
CADMIUM**	7440-43-9	7	EPA RSL	0.36	EPA SSL Wildlife	0.36	0.12	0.1	0.02	0.0076
CALCIUM**	7440-70-2	NC	None	NC	None	NC	NC	10	8	3.83
CHROMIUM**	7440-47-3	22,000	EPA RSL	26	EPA SSL Wildlife	26	8.7	0.4	0.3	0.05
HEXAVALENT CHROMIUM	18540-29-9	0.3	EPA RSL	0.4	ORNL Invert	0.3	0.1	0.41	0.21	0.023 ¹
COBALT**	7440-48-4	2.3	EPA RSL	13	EPA SSL Plant	2.3	0.8	0.1	0.03	0.0054
COPPER**	7440-50-8	310	EPA RSL	28	EPA SSL Wildlife	28	9.3	0.3	0.2	0.071
IRON**	7439-89-6	5500	EPA RSL	200	ORNL Invert	200	66.7	10	6	2.4
LEAD**	7439-92-1	340	MEDEP RAG	11	EPA SSL Wildlife	11	3.7	0.1	0.05	0.007
MERCURY	7439-97-6	0.94	EPA RSL	0.013	LANL Wildlife	0.013	0.004	0.033	0.017	0.0052
MAGNESIUM**	7439-95-4	NC	None	NC	None	NC	NC	10	8	1.37
MANGANESE**	7439-96-5	180	EPA RSL	220	EPA SSL Plant	180	60	0.2	0.1	0.042
NICKEL**	7440-02-0	150	EPA RSL	38	EPA SSL Plant	38	12.7	0.2	0.12	0.026
POTASSIUM**	7440-09-7	NC	None	NC	None	NC	NC	100	40	4.6
SELENIUM**	7782-49-2	39	EPA RSL	0.52	EPA SSL Plant	0.52	0.17	0.5	0.3	0.039
SILVER**	7440-22-4	39	EPA RSL	4.2	EPA SSL Wildlife	4.2	1.4	0.1	0.04	0.0066
SODIUM**	7440-23-5	NC	None	NC	None	NC	NC	100	40	2.6
THALLIUM**	7440-28-0	0.078	EPA RSL	0.032	LANL Wildlife	0.032	0.011	0.1	0.04	0.0094
VANADIUM**	7440-62-2	39 ²	EPA RSL	7.8	EPA SSL Wildlife	7.8	2.6	0.5	0.4	0.11
ZINC**	7440-66-6	2300	EPA RSL	46	EPA SSL Wildlife	46	15.3	1	0.8	0.13
TARGET COMPOUND LIST VOLATILE OR	GANIC COMPOUN	DS						•	•	
1,1- DICHLOROETHANE	75-34-3	3.6	EPA RSL	0.02	Target Value	0.02	0.007	0.005	0.0025	0.0017
1,1,1-TRICHLOROETHANE	71-55-6	810	EPA RSL	0.07	Target Value	0.07	0.02	0.005	0.0025	0.00042
1,1,2- TRICHLOROETHANE	79-00-5	0.15	EPA RSL	0.4	Target Value	0.15	0.05	0.005	0.0025	0.00097
1,1,2,2- TETRACHLORETHANE	79-34-5	0.60	EPA RSL	0.127	Region 5 Wildlife	0.127	0.04	0.005	0.0025	0.00084
1,1,2-TRICHLORO-1,2,2-TRIFLUORO- ETHANE	76-13-1	4000	EPA RSL	NC	NC	4000	1300	0.005	0.0025	0.0009
1,1-DICHLOROETHENE	75-35-4	23	EPA RSL	0.1	Target Value	0.1	0.03	0.005	0.0025	0.00093
1,2- DICHLOROBENZENE	95-50-1	180	EPA RSL	0.92	LANL Wildlife	0.92	0.31	0.005	0.0025	0.00078
1,2- DICHLOROETHANE	107-06-2	0.46	EPA RSL	0.02	Target Value	0.02	0.007	0.005	0.0025	0.001
1,2,3-TRICHLOROBENZENE	87-61-6	4.9	EPA RSL	20	ORNL Invert	4.9	1.6	0.005	0.0025	0.00076

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
1,2,4-TRICHLOROBENZENE	120-82-1	5.8	EPA RSL	11.1	Region 5 Wildlife	5.8	1.9	0.005	0.0025	0.00079
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.0053	EPA RSL	0.0352	Region 5 Wildlife	0.0053	0.002	0.005	0.0025	0.0015
1,2-DIBROMOETHANE	106-93-4	0.036	EPA RSL	1.23	Region 5 Wildlife	0.036	0.012	0.005	0.0025	0.0012
1,2-DICHLOROPROPANE	78-87-5	1.0	EPA RSL	0.002	Target Value	0.002	0.00067	0.005	0.0025	0.0014
1,3-DICHLOROBENZENE	541-73-1	NC	None	0.73	LANL Wildlife	0.73	0.24	0.005	0.0025	0.00062
1,4- DICHLOROBENZENE	106-46-7	2.6	EPA RSL	0.88	LANL Wildlife	0.88	0.29	0.005	0.0025	0.00044
2-BUTANONE	78-93-3	2700	EPA RSL	360	LANL Wildlife	360	120	0.025	0.0125	0.0059
2-HEXANONE	591-78-6	20	EPA RSL	0.36	LANL Wildlife	0.36	0.12	0.025	0.0125	0.0048
4-METHYL-2-PENTANONE	108-10-1	530	EPA RSL	9.8	LANL Wildlife	9.8	3.3	0.025	0.0125	0.0059
ACETONE	67-64-1	6100	EPA RSL	1.2	LANL Wildlife	1.2	0.4	0.025	0.0125	0.0051
BENZENE	71-43-2	1.2	EPA RSL	25	CCME Wildlife	1.2	0.4	0.005	0.0025	0.00092
BROMOCHLOROMETHANE	74-97-5	15	EPA RSL	NC	NC	15	5	0.005	0.0025	0.00091
BROMODICHLOROMETHANE	75-27-4	0.29	EPA RSL	0.54	Region 5 Wildlife	0.29	0.1	0.005	0.0025	0.0006
BROMOFORM	75-25-2	67	EPA RSL	15.9	Region 5 Wildlife	15.9	5.3	0.005	0.0025	0.0007
BROMOMETHANE	74-83-9	0.68	EPA RSL	0.235	Region 5 Wildlife	0.235	0.078	0.010	0.005	0.0011
CARBON DISULFIDE	75-15-0	77	EPA RSL	0.82	LANL Wildlife	0.82	0.27	0.005	0.0025	0.00078
CARBON TETRACHLORIDE	56-23-5	0.65	EPA RSL	2.98	Region 5 Wildlife	0.65	0.22	0.005	0.0025	0.0013
CHLOROBENZENE	108-90-7	28	EPA RSL	0.03	Target Value	0.03	0.01	0.005	0.0025	0.00051
CHLOROETHANE	75-00-3	1400	EPA RSL	NC	None	1400	460	0.010	0.005	0.0013
CHLOROFORM	67-66-3	0.32	EPA RSL	8	LANL Wildlife	0.32	0.11	0.005	0.0025	0.00035
CHLOROMETHANE	74-87-3	11	EPA RSL	10.4	Region 5 Wildlife	10.4	3.6	0.010	0.005	0.0014
CIS-1,2- DICHLOROETHENE	156-59-2	16	EPA RSL	0.2	Target Value	0.2	0.067	0.005	0.0025	0.00091
CIS-1,3- DICHLOROPROPENE	10061-01-5	1.8 ³	EPA RSL	0.2	Target Value	0.2	0.067	0.005	0.0025	0.00072
CYCLOHEXANE	110-82-7	650	EPA RSL	NC	None	650	220	0.005	0.0025	0.0014
DIBROMOCHLOROMETHANE	124-48-1	0.73	EPA RSL	2.05	Region 5 Wildlife	0.73	0.24	0.005	0.0025	0.001
DICHLORODIFLUOROMETHANE	75-71-8	8.7	EPA RSL	39.5	Region 5 Wildlife	8.7	2.9	0.010	0.005	0.00092
ETHYLBENZENE	100-41-4	5.8	EPA RSL	5.16	Region 5 Wildlife	5.16	1.7	0.005	0.0025	0.00065
ISOPROPYLBENZENE	98-82-8	190	EPA RSL	NC	None	190	63	0.005	0.0025	0.00092
METHYL ACETATE	79-20-9	7800	EPA RSL	NC	None	7800	2600	0.005	0.003	0.0027
METHYL TERT-BUTYL ETHER	1634-04-4	47	EPA RSL	NC	None	47	16	0.005	0.0025	0.0011
METHYLCYCLOHEXANE	108-87-2	NC	None	NC	NC	NA	NA	0.005	0.0025	0.00096
METHYLENE CHLORIDE	75-09-2	35	EPA RSL	2.6	LANL Wildlife	2.6	0.87	0.025	0.0125	0.0079
STYRENE	100-42-5	600	EPA RSL	1.2	LANL Invert	1.2	0.4	0.005	0.0025	0.00051
TETRACHLOROETHENE	127-18-4	8.1	EPA RSL	0.002	Target Value	0.002	0.00067	0.005	0.0025	0.0012
TOLUENE	108-88-3	490	EPA RSL	75	CCME	75	25	0.005	0.0025	0.0014
O-XYLENE	95-47-6	65	EPA RSL	95	CCME Plant/Invert.	65	22	0.005	0.0025	0.0013
m,p-XYLENE	108-38-3	55	EPA RSL	95	CCME Plant/Invert.	55	18	0.010	0.0005	0.0017
TOTAL XYLENES	1330-20-7	58	EPA RSL	NC	None	58	19	0.015	0.0075	0.0013
TRANS-1,2- DICHLOROETHENE	156-60-5	160	EPA RSL	0.2	Target Value	0.2	0.07	0.005	0.0025	0.00071
TRANS-1,3-DICHLOROPROPENE	10061-02-6	1.8 3	EPA RSL	0.2	Target Value	0.2	0.07	0.005	0.0025	0.00086
TRICHLOROETHENE	79-01-6	0.41	EPA RSL	0.1	Target Value	0.1	0.03	0.005	0.0025	0.00059
TRIGHTORUETHEINE	19-01-0	0.41	EFAROL	U. I	raiget value	U. I	0.03	0.005	0.0023	0.00059

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
TRICHLOROFLUOROMETHANE	75-69-4	73	EPA RSL	16.4	Region 5 Wildlife	16.4	5.5	0.010	0.005	0.00091
VINYL CHLORIDE	75-01-4	0.059	EPA RSL	0.01	Target Value	0.01	0.003	0.010	0.005	0.00087
TARGET COMPOUND LIST SEMI-VOLATILI	E ORGANIC COM	POUNDS								
1,1'-BIPHENYL	92-52-4	4.7	EPA RSL	60	ORNL Plant	4.7	1.6	0.33	0.25	0.073
1,4-DIOXANE* (SIM)	123-91-1	5.3	EPA RSL	2.05	Region 5 Wildlife	2.05	0.68	0.5	0.25	0.033
1,2,4,5-TETRACHLOROBENZENE	95-94-3	1.8	EPA RSL	2.02	Region 5 Wildlife	1.8	0.6	0.33	0.25	0.135
2,2-OXYBIS(1-CHLOROPROPANE)	108-60-1	4.9	EPA RSL	19.9	Region 5 Wildlife	4.9	1.6	0.33	0.25	0.089
2,3,4,6-TETRACHLOROPHENOL* (SIM)	58-90-2	180	EPA RSL	0.199	Region 5 Wildlife	0.199	0.06	0.1	0.05	0.0027
2,4,5-TRICHLOROPHENOL	95-95-4	620	EPA RSL	4	ORNL Plant	4	1.3	0.82	0.615	0.155
2,4,6-TRICHLOROPHENOL	88-06-2	6.2	EPA RSL	9.94	Region 5 Wildlife	6.2	2	0.33	0.248	0.155
2,4-DICHLOROPHENOL	120-83-2	18	EPA RSL	87.5	Region 5 Wildlife	18	6	0.33	0.248	0.15
2,4-DIMETHYLPHENOL	105-67-9	120	EPA RSL	NC	None	120	40	0.33	0.248	0.165
2,4-DINITROPHENOL* (SIM)	51-28-5	12	EPA RSL	0.0609	Region 5 Wildlife	0.0609	0.02	0.1	0.075	0.063
2,4-DINITROTOLUENE	121-14-2	1.7	EPA RSL	2.5	LANL Wildlife	1.7	0.57	0.33	0.248	0.085
2,6-DINITROTOLUENE* (SIM)	606-20-2	0.36	EPA RSL	1.8	LANL Wildlife	0.36	0.12	0.02	0.01	0.0043
2-CHLORONAPHTHALENE* (SIM)	91-58-7	630	EPA RSL	0.0122	Region 5 Wildlife	0.0122	0.004	0.02	0.01	0.0036
2-CHLOROPHENOL* (SIM)	95-57-8	39	EPA RSL	0.39	LANL Wildlife	0.39	0.13	0.1	0.05	0.0053
2-METHYLNAPHTHALENE* (SIM)	91-57-6	23	EPA RSL	29	EPA SSL Invert	23	7.7	0.02	0.01	0.0017
2-METHYLPHENOL* (SIM)	95-48-7	310	EPA RSL	0.05	Target Value	0.05	0.017	0.1	0.05	0.0085
2-NITROANILINE	88-74-4	61	EPA RSL	5.4	LANL Wildlife	5.4	1.8	0.82	0.615	0.075
2-NITROPHENOL	88-75-5	NC	None	1.6	Region 5 Wildlife	1.6	0.53	0.33	0.25	0.167
3,3'-DICHLOROBENZIDINE* (SIM)	91-94-1	1.2	EPA RSL	0.646	Region 5 Wildlife	0.646	0.21	0.02	0.01	0.003
3-NITROANILINE	99-09-2	25 ⁴	EPA RSL	3.16	Region 5 Wildlife	3.16	1	0.82	0.615	0.094
4,6-DINITRO-2-METHYLPHENOL* (SIM)	534-52-1	0.49	EPA RSL	0.144	Region 5 Wildlife	0.144	0.048	0.2	0.1	0.024
4-BROMOPHENYL-PHENYLETHER	101-55-3	NC	None	NC	None	NC	NC	0.33	0.25	0.085
4-CHLORO-3-METHYLPHENOL	59-50-7	620	EPA RSL	7.95	Region 5 Wildlife	7.95	2.6	0.33	0.25	0.166
4-CHLOROANILINE	106-47-8	2.7	EPA RSL	1	LANL Plant	1	0.33	0.33	0.25	0.119
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NC	None	NC	None	NC	NC	0.33	0.25	0.078
4-METHYLPHENOL* (SIM)	106-44-5	620	EPA RSL	0.05	Target Value	0.05	0.017	0.1	0.05	0.0099
4-NITROANILINE	100-01-6	25	EPA RSL	21.9	Region 5 Wildlife	21.9	7.3	0.82	0.615	0.134
4-NITROPHENOL	100-02-7	NC	None	5.12	Region 5 Wildlife	5.12	1.7	0.82	0.615	0.309
ACENAPHTHENE* (SIM)	83-32-9	350	EPA RSL	20	ORNL Plant	20	6.7	0.02	0.01	0.0015
ACENAPHTHYLENE* (SIM)	208-96-8	350 ⁵	EPA RSL	20	ORNL Plant	20	6.7	0.02	0.01	0.0012
ANTHRACENE* (SIM)	120-12-7	1700	EPA RSL	2.5	CCME Plant/Invert.	2.5	0.83	0.02	0.01	0.0012
ATRAZINE	1912-24-9	2.3	EPA RSL	NC	None	2.3	0.77	0.33	0.25	0.091
BENZALDEHYDE	100-52-7	780	EPA RSL	NC	None	780	260	0.33	0.25	0.12
BENZO (A) ANTHRACENE* (SIM)	56-55-3	0.15	EPA RSL	1.1	EPA SSL Wildlife	0.15	0.05	0.02	0.01	0.0019
BENZO (A) PYRENE* (SIM)	50-32-8	0.015	EPA RSL	1.1	EPA SSL Wildlife	0.015	0.005	0.02	0.01	0.0033
BENZO (B) FLUOROANTHENE* (SIM)	205-99-2	0.15	EPA RSL	1.1	EPA SSL Wildlife	0.15	0.05	0.02	0.01	0.0024
BENZO (G,H,I) PERYLENE* (SIM)	191-24-2	170 ⁶	EPA RSL	1.1	EPA SSL Wildlife	1.1	0.37	0.02	0.01	0.002

CTO 69 031303/P

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
BENZO (K) FLUOROANTHENE* (SIM)	207-08-9	1.5	EPA RSL	1.1	EPA SSL Wildlife	1.1	0.37	0.02	0.01	0.0031
BIS(2-CHLOROETHOXY) METHANE* (SIM)	111-91-1	18	EPA RSL	0.302	Region 5 Wildlife	0.302	0.1	0.02	0.01	0.0064
BIS-(2-CHLOROETHYL) ETHER* (SIM)	111-44-4	0.23	EPA RSL	23.7	Region 5 Wildlife	0.23	0.08	0.02	0.01	0.0017
BIS(2-ETHYLHEXYL) PHTHALATE* (SIM)	117-81-7	38	EPA RSL	0.02	LANL Wildlife	0.02	0.007	0.1	0.05	0.032
BUTYLBENZYLPHTHALATE* (SIM)	85-68-7	280	EPA RSL	90	LANL Wildlife	90	30	0.1	0.05	0.004
CAPROLACTAM	105-60-2	3100	EPA RSL	NC	None	3100	1000	0.33	0.25	0.144
CARBAZOLE	86-74-8	NC	None	80	LANL Wildlife	80	27	0.33	0.25	0.111
CHRYSENE* (SIM)	218-01-9	15	EPA RSL	1.1	EPA SSL Wildlife	1.1	0.37	0.02	0.01	0.0017
DIBENZO (A,H)ANTHRACENE* (SIM)	53-70-3	0.015	EPA RSL	1.1	EPA SSL Wildlife	0.015	0.005	0.02	0.01	0.0018
DIBENZOFURAN	132-64-9	7.2	EPA RSL	6.1	LANL Plant	6.1	2	0.33	0.25	0.079
DIETHYLPHTHALATE	84-66-2	4900	EPA RSL	24.8	Region 5 Wildlife	24.8	8.3	0.33	0.25	0.08
DIMETHYLPHTHALATE	131-11-3	NC	None	200	ORNL Plant	200	66.7	0.33	0.25	0.078
DI-N-BUTYLPHTHALATE* (SIM)	84-74-2	620	EPA RSL	0.011	LANL Wildlife	0.011	0.004	0.1	0.05	0.0168
DI-N-OCTYLPHTHALATE* (SIM)	117-84-0	62	EPA RSL	0.91	LANL Wildlife	0.91	0.3	0.1	0.05	0.046
FLUORANTHENE* (SIM)	206-44-0	230	EPA RSL	29	EPA SSL Invert	29	9.7	0.02	0.01	0.0018
FLUORENE* (SIM)	86-73-7	230	EPA RSL	29	EPA SSL Invert	29	9.7	0.02	0.01	0.0032
HEXACHLOROBENZENE* (SIM)	118-74-1	0.33	EPA RSL	0.079	LANL Wildlife	0.079	0.03	0.02	0.01	0.0018
HEXACHLOROBUTADIENE* (SIM)	87-68-3	6.2	EPA RSL	0.0398	Region 5 Wildlife	0.0398	0.013	0.02	0.01	0.0023
HEXACHLOROCYCLOPENTADIENE* (SIM)	77-47-4	37	EPA RSL	0.755	Region 5 Wildlife	0.755	0.25	0.02	0.01	0.0015
HEXACHLOROETHANE* (SIM)	67-72-1	4.3	EPA RSL	0.596	Region 5 Wildlife	0.596	0.2	0.02	0.01	0.002
INDENO (1,2,3-CD)-PYRENE* (SIM)	193-39-5	0.15	EPA RSL	1.1	EPA SSL Wildlife	0.15	0.05	0.02	0.01	0.0019
ISOPHORONE	78-59-1	560	EPA RSL	139	Region 5 Wildlife	139	46.3	0.33	0.25	0.075
NAPHTHALENE* (SIM)	91-20-3	3.8	EPA RSL	1	LANL Plant	1	0.33	0.02	0.01	0.0026
NITROBENZENE	98-95-3	5.1	EPA RSL	4.9	LANL Wildlife	4.9	1.6	0.33	0.25	0.091
N-NITROSO DIPHENYLAMINE	86-30-6	110	EPA RSL	0.545	Region 5 Wildlife	0.545	0.18	0.33	0.25	0.219
N-NITROSO-DI-N PROPYLAMINE* (SIM)	621-64-7	0.076	EPA RSL	0.544	Region 5 Wildlife	0.076	0.025	0.02	0.01	0.0019
PENTACHLOROPHENOL (SIM)	87-86-5	0.99	EPA RSL	2.1	EPA SSL Wildlife	0.99	0.33	0.01	0.05	0.014
PHENANTHRENE* (SIM)	85-01-8	170 ⁶	EPA RSL	29	EPA SSL Invert	29	9.7	0.02	0.01	0.0018
PHENOL	108-95-2	1800	EPA RSL	20	CCME Plant/Invert.	20	6.7	0.33	0.25	0.156
PYRENE* (SIM)	129-00-0	170	EPA RSL	1.1	EPA SSL Wildlife	1.1	0.37	0.02	0.01	0.0021
EXPLOSIVES		•	•	•				•		
1,3,5-TRINITROBENZENE	99-35-4	220	EPA RSL	6.6	LANL Wildlife	6.6	2.2	0.1	0.05	0.0067
1,3-DINITROBENZENE	99-65-0	0.62	EPA RSL	0.073	LANL Wildlife	0.073	0.02	0.1	0.05	0.0062
2,4-DINITROTOLUENE	121-14-2	1.7	EPA RSL	2.5	LANL Wildlife	1.7	0.57	0.1	0.05	0.015
2,6-DINITROTOLUENE	606-20-2	0.36	EPA RSL	1.8	LANL Wildlife	0.36	0.12	0.1	0.05	0.027
NITROBENZENE	98-95-3	5.1	EPA RSL	4.9	LANL Wildlife	4.9	1.6	0.1	0.05	0.022
2,4,6-TRINITROTOLUENE	118-96-7	3.6	EPA RSL	6	Sunahara Plant	3.6	1.2	0.1	0.05	0.0067
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	15	EPA RSL	10	LANL Wildlife	10	3.3	0.1	0.05	0.021
2-NITROTOLUENE	88-72-2	3.2	EPA RSL	9.9	LANL Wildlife	3.2	1.1	0.1	0.05	0.012
3-NITROTOLUENE	99-08-1	0.62	EPA RSL	12	LANL Wildlife	0.62	0.2	0.1	0.05	0.0079
3,5-DINITROANILINE	618-87-1	NC	None	NC	None	NC	NC	0.1	0.05	0.0035

CTO 69 031303/P

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	15	EPA RSL	3.6	LANL Wildlife	3.6	1.2	0.1	0.05	0.017
4-NITROTOLUENE	99-99-0	25	EPA RSL	22	LANL Wildlife	22	7	0.1	0.05	0.027
HMX	2691-41-0	380	EPA RSL	16	Draft Eco SSL	16	5	0.1	0.05	0.0086
TETRYL	479-45-8	12	EPA RSL	0.99	LANL Wildlife	0.99	0.33	0.1	0.05	0.0054
RDX	121-82-4	6.0	EPA RSL	12	LANL Wildlife	6	2	0.1	0.05	0.0068
PETN	78-11-5	12	EPA RSL	100	LANL Wildlife	12	4	0.8	0.4	0.108
NITROGLYCERIN	55-63-0	0.62	EPA RSL	13	Draft Eco SSL	0.62	0.21	0.8	0.4	0.124
TARGET COMPOUND LIST PESTICIDES	(Katahdin will re	eference Low Lev	el Modification	n, with extract	Final Volume = 2 mls	5)		4	•	
4,4'-DDD	72-54-8	2.2	EPA RSL	0.021	EPA SSL Wildlife	0.021	0.007	0.00066	0.00033	0.00004
4,4'-DDE	72-55-9	1.6	EPA RSL	0.021	EPA SSL Wildlife	0.021	0.007	0.00066	0.00033	0.000038
4,4'-DDT	50-29-3	1.9	EPA RSL	0.021	EPA SSL Wildlife	0.021	0.007	0.00066	0.00033	0.000062
ALDRIN	309-00-2	0.031	EPA RSL	0.00006	Target Value	0.00006	0.00002	0.00034	0.00017	0.000056
ALPHA-BHC	319-84-6	0.085	EPA RSL	0.003	Target Value	0.003	0.001	0.00034	0.00017	0.000068
ALPHA-CHLORDANE	5103-71-9	1.8 7	EPA RSL	0.00003	Target Value	0.00003	0.00001	0.00034	0.00017	0.000042
BETA-BHC	319-85-7	0.30	EPA RSL	0.009	Target Value	0.009	0.003	0.00034	0.00017	0.000066
DELTA-BHC	319-86-8	NC	EPA RSL	9.94	Region 5 Wildlife	9.94	3.3	0.00034	0.00017	0.000064
DIELDRIN	60-57-1	0.033	EPA RSL	0.0005	Target Value	0.0005	0.0002	0.00066	0.00033	0.000044
ENDOSULFAN I	959-98-8	37 ⁸	EPA RSL	0.00001	Target Value	0.00001	0.000003	0.000340	0.00017	0.00024/5
ENDOSULFAN II	33213-65-9	37 ⁸	EPA RSL	0.00001	Target Value	0.00001	0.00003	0.000660	0.00033	0.000068
ENDOSULFAN SULFATE	1031-07-8	37 ⁸	EPA RSL	0.00001	Target Value	0.00001	0.00003	0.000660	0.00033	0.000116
ENDRIN	72-20-8	1.8	EPA RSL	0.00004	Target Value	0.00004	0.000013	0.000660	0.00033	0.00017
ENDRIN ALDEHYDE	7421-93-4	1.8 ⁹	EPA RSL	0.00004	Target Value	0.00004	0.000013	0.000660	0.00033	0.000098
ENDRIN KETONE	53494-70-5	1.8 ⁹	EPA RSL	0.00004	Target Value	0.00004	0.000013	0.000660	0.00033	0.00008
GAMMA-BHC (LINDANE)	58-89-9	0.56	EPA RSL	0.00005	Target Value	0.00005	0.000017	0.000340	0.00017	0.000046
GAMMA-CHLORDANE	5103-74-2	1.8 7	EPA RSL	0.00003	Target Value	0.00003	0.00001	0.00034	0.00017	0.000046
HEPTACHLOR	76-44-8	0.12	EPA RSL	0.0007	Target Value	0.0007	0.00023	0.00034	0.00017	0.000058
HEPTACHLOR EPOXIDE	1024-57-3	0.059	EPA RSL	0.0000002	Target Value	0.0000002	0.0000007	0.00034000	0.00017	0.000044
METHOXYCHLOR	72-43-5	31	EPA RSL	5	LANL Wildlife	5	1.7	0.0034	0.0017	0.0001
TOXAPHENE	8001-35-2	0.48	EPA RSL	4.1	LANL Wildlife	0.48	0.16	0.0066	0.0032	0.0014
TARGET COMPOUND LIST POLYCHLORII	NATED BIPHENYL	Ss (Katahdin will ı	reference Low	Level Modific	ation with extract Fin	al Volume = 2	mls.)			
AROCLOR-1016	12674-11-2	0.40	EPA RSL	1.3	CCME Wildlife	0.40	0.13	0.0034	0.0017	0.0012
AROCLOR-1221	11104-28-2	0.15	EPA RSL	1.3	CCME Wildlife	0.15	0.05	0.0034	0.0017	0.00158
AROCLOR-1232	11141-16-5	0.15	EPA RSL	1.3	CCME Wildlife	0.15	0.05	0.0034	0.002	0.00186
AROCLOR-1242	53469-21-9	0.24	EPA RSL	1.3	CCME Wildlife	0.24	0.08	0.0034	0.0017	0.00122
AROCLOR-1248	12672-29-6	0.24	EPA RSL	1.3	CCME Wildlife	0.24	0.08	0.0034	0.0017	0.00122
AROCLOR-1254	11097-69-1	0.11	EPA RSL	1.3	CCME Wildlife	0.11	0.04	0.0034	0.0017	0.00094
AROCLOR-1260	11096-82-5	0.24	EPA RSL	1.3	CCME Wildlife	0.28	0.08	0.0034	0.0017	0.0012
AROCLOR-1262	37324-23-5	NC	EPA RSL	1.3	CCME Wildlife	1.3	0.4	0.0034	0.0017	0.0005
AROCLOR-1268	11100-14-4	NC	EPA RSL	1.3	CCME Wildlife	1.3	0.4	0.0034	0.0017	0.0005

CTO 69 031303/P

Date: September 2014 Worksheet 15 Page 71 of 178

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
Petroleum Hydrocarbon Fraction (EPH/VPH)										
C5-C8 aliphatics (VPH)		1,400	MEDEP	NC	None	1,400	470	25	19	12.5
C9-C12 Aliphatics(VPH)		2,700	MEDEP	NC	None	2,700	900	25	19	12.5
C9-C18 Aliphatics (EPH)		2,700	MEDEP	NC	None	2,700	900	20	15	10
C19-C36 Aliphatics (EPH)		10,000 ¹⁰	MEDEP	NC	None	10,000 ¹⁰	3300	20	15	10
C9-C10 Aromatics(VPH)		75	MEDEP-L	NC	None	75	25	25	19	12.5
C11-C22 Aromatics (EPH)		460	MEDEP-L	NC	None	460	150	20	15	10

Bolded rows indicate that either the human health or ecological PSL is between the laboratory LOQ and LOD. The Partnering Team has agreed to accept these data for decision making if results less than the LOQ are "J" qualified and if the results are discussed in the RI.

Shaded and bolded rows indicate that either the human health or ecological PSL is less than the LOD. In cases where the LOD is greater than the PSL and the contaminant was not detected, the contaminant will not be retained as a COPC. However, the uncertainty associated with this decision will be discussed in the risk assessment section. Moreover, a discussion regarding the likelihood of the presence of that contaminant (e.g., based on historical site uses) will be included in the risk assessment section.

CAS = Chemical Abstract Service.

PQLG = Project Quantitation Limit Goal.

MEDEP RAG = Maine Department of Environmental Protection remedial action guidelines.

NC = No criterion.

RSL = Regional Screening Levels

Note: At the time of data evaluation, the most recent screening criteria will be used for the HHRA and ERA.

Human Health PSL References

EPA RSL: USEPA Regions 3, 6, and 9 Regional Screening Levels for Soil, Residential (USEPA, May 2014). EPA RSLs for non-carcinogens in residential soil are adjusted by dividing by 10, equivalent to hazard quotients of 0.1. The EPA RSLs for carcinogens in residential soil are not adjusted and are equivalent to ILCRs of 1E-6

MEDEP Table 4 - Tier 1 Direct Contact Soil Remediation Guidelines for Smaller Petroleum Contamination Sites (MEDEP, 2014) MEDEP-L Table 3 - Tier 1 Soil Remediation Guideline Based on Petroleum Leaching to Ground Water (MEDEP, 2014).

Ecological PSL References

The selected ecological Soil Screening Levels (SSLs) are the lowest of the selected benchmarks for plants, invertebrates, and wildlife. The benchmarks were selected by order of preference according to the hierarchies below:

Screening Level Order of Preference for Plants and Invertebrates:

- 1. EPA SSL Plant or Invertebrate USEPA Eco SSL EPA Ecological Soil Screening Levels [USEPA, 2007 (separate documents for each chemical)]
- 2. Draft Eco SSL Draft Ecological Soil Screening Levels (SERDP, 2012)
- 3. CCME Plant/ Invertebrate CCME Canadian Council and Ministers of Environment (CCME, 1999)
- 4a. ORNL Plant. ORNL Benchmark (Efroymson, 1997a) Oak Ridge National Laboratory Plant Toxicological Benchmark (Efroymson, 1997a)
- 4b. ORNL Invertebrate ORNL Benchmark (Efroymson, 1997b) Oak Ridge National Laboratory Invertebrate Toxicological Benchmark (Efroymson, 1997b)
- 5. Sunahara Plant/Invert Ecotoxicology of Explosives (Sunahara et al., 2009)

^{**} These metals will be analyzed by SW-846 6020.

^{* (}SIM) Indicates that these compounds will be reported from a Selected Ion Monitoring (SIM) analysis. Pesticide and PCB analyses will be concentrated to a 2 mL final volume to achieve lower detection limits.

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date: September 2014 Worksheet 15 Page 72 of 178

- 6 LANL Plant/Invert Los Alamos National Laboratory EcoRISK Database (Release 3.1) (LANL, 2012)
- 7. Target Value Ministry of Housing, Spatial Planning and Environment (MHSPE, 2000)

Screening Level Order of Preference for Wildlife:

- 1. USEPA Eco SSL EPA Ecological Soil Screening Levels (EPA SSL Wildlife) [USEPA, 2007 (separate documents for each chemical)]
- 2 CCME Canadian Council and Ministers of Environment (CCME Wildlife) (presented only if no EPA SSL is available)
- 3.Los Alamos National Laboratory EcoRISK Database (Release 3.1) (LANL, 2012)
- 4. USEPA Region 5 ESL EPA Region 5 Ecological Screening Levels (ESL) (Region 5 ESL) (USEPA, 2003a)

Footnotes

- 1 Hexavalent chromium analysis will be conducted by ALS. ALS LOQs, LODs, and DLs are provided.
- 2 The value presented is for vanadium and compounds.
- 3 The value presented is for 1,3-dichloropropene.
- 4 The value presented is for 4-nitroaniline.
- 5 The value presented is for acenaphthene.
- 6 The value presented is for pyrene.
- 7 The value presented is for chlordane.
- 8 The value presented is for endosulfan.
- 9 The value presented is for endrin.
- 10 Value is greater than ceiling value of 10,000 mg/kg; therefore, the ceiling value is used as the human health PSL for this parameter.

SAP Worksheet #15b -- Reference Limits and Evaluation Table - Sediment

Project screening-level support documentation is provided in Appendix B.

(UFP-QAPP Manual Section 2.8.1)

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
TARGET ANALYTE LIST METALS										
ALUMINUM**	7429-90-5	7700	EPA RSL	25500	NOAA	7700	2600	30	4	0.51
ANTIMONY**	7440-36-0	3.1	EPA RSL	3	NOAA	3	1	0.1	0.05	0.02
ARSENIC**	7440-38-2	0.67	EPA RSL	9.79	TEC	0.67	0.22	0.5	0.4	0.15
BARIUM**	7440-39-3	1500	EPA RSL	48	NOAA	48	16	0.2	0.1	0.037
BERYLLIUM**	7440-41-7	16	EPA RSL	NC	None	16	5.3	0.1	0.02	0.0041
CADMIUM**	7440-43-9	7	EPA RSL	0.99	TEC	0.99	0.33	0.1	0.02	0.007
CALCIUM**	7440-70-2	NC	None	NC	None	NC	NC	10	8	3.83
CHROMIUM**	7440-47-3	2,2000	EPA RSL	43.4	TEC	43.4	14.5	0.4	0.3	0.05
HEXAVALENT CHROMIUM	18540-29-9	0.3	Residential RSL	43.4	TEC	0.3	0.1	0.41	0.21	0.023 ¹
COBALT**	7440-48-4	2.3	EPA RSL	50	LEL	2.3	0.77	0.1	0.03	0.0054
COPPER**	7440-50-8	310	EPA RSL	31.6	TEC	31.6	10.5	0.3	0.2	0.071
IRON**	7439-89-6	5500	EPA RSL	20000	LEL	5500	1800	10	6	2.4
LEAD**	7439-92-1	400	EPA RSL	35.8	TEC	35.8	11.9	0.1	0.05	0.007
MERCURY	7439-97-6	0.94	EPA RSL	0.18	TEC	0.18	0.06	0.033	0.017	0.0052
MAGNESIUM**	7439-95-4	NC	None	NC	None	NC	NC	10	8	1.37
MANGANESE**	7439-96-5	180	EPA RSL	460	LEL	180	60	0.2	0.1	0.042
NICKEL**	7440-02-0	150	EPA RSL	22.7	TEC	22.7	7.6	0.2	0.12	0.026
POTASSIUM**	7440-09-7	NC	None	NC	None	NC	NC	100	40	4.6
SELENIUM**	7782-49-2	39	EPA RSL	1	NOAA	1	0.33	0.5	0.3	0.039
SILVER**	7440-22-4	39	EPA RSL	0.5	LEL	0.5	0.17	0.1	0.04	0.0066
SODIUM**	7440-23-5	NC	None	NC	None	NC	NC	100	40	2.6
THALLIUM**	7440-28-0	0.078	EPA RSL	NC	None	0.078	0.026	0.1	0.04	0.0094
VANADIUM**	7440-62-2	39 ²	EPA RSL	57	NOAA	39	13	0.5	0.4	0.11
ZINC**	7440-66-6	2300	EPA RSL	121	TEC	121	40.3	1	0.8	0.13
TARGET COMPOUND LIST VOLATILE ORGA	ANIC COMPOUNI	DS								
1,1- DICHLOROETHANE	75-34-3	3.6	EPA RSL	0.027	SCV	0.027	0.009	0.005	0.0025	0.0017
1,1,1-TRICHLOROETHANE	71-55-6	810	EPA RSL	0.17	EPA SQB	0.17	0.06	0.005	0.0025	0.00042
1,1,2- TRICHLOROETHANE	79-00-5	0.15	EPA RSL	1.2	SCV	0.15	0.05	0.005	0.0025	0.00097
1,1,2,2- TETRACHLORETHANE	79-34-5	0.60	EPA RSL	0.94	EPA SQB	0.60	0.2	0.005	0.0025	0.00084
1,1,2-TRICHLORO-1,2,2-TRIFLUORO- ETHANE	76-13-1	4000	EPA RSL	NC	None	4000	1300	0.005	0.0025	0.0009
1,1-DICHLOROETHENE	75-35-4	23	EPA RSL	0.031	SCV	0.031	0.01	0.005	0.0025	0.00093
1,2- DICHLOROBENZENE	95-50-1	180	EPA RSL	0.34	EPA SQB	0.34	0.11	0.005	0.0025	0.00078
1,2- DICHLOROETHANE	107-06-2	0.46	EPA RSL	0.25	SCV	0.25	0.08	0.005	0.0025	0.001

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
1,2,3-TRICHLOROBENZENE	87-61-6	4.9	EPA RSL	NC	None	4.9	1.6	0.005	0.0025	0.00076
1,2,4-TRICHLOROBENZENE	120-82-1	5.8	EPA RSL	9.2	EPA SQB	5.8	1.9	0.005	0.0025	0.00079
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.0053	EPA RSL	NC	None	0.0053	0.002	0.005	0.0025	0.0015
1,2-DIBROMOETHANE	106-93-4	0.036	EPA RSL	NC	None	0.036	0.012	0.005	0.0025	0.0012
1,2-DICHLOROPROPANE	78-87-5	1.0	EPA RSL	0.333	ESV	0.333	0.111	0.005	0.0025	0.0014
1,3-DICHLOROBENZENE	541-73-1	NC	None	1.7	EPA SQB	1.7	0.57	0.005	0.0025	0.00062
1,4- DICHLOROBENZENE	106-46-7	2.6	EPA RSL	0.35	EPA SQB	0.35	0.12	0.005	0.0025	0.00044
2-BUTANONE	78-93-3	2700	EPA RSL	0.27	SCV	0.27	0.09	0.025	0.0125	0.0059
2-HEXANONE	591-78-6	20	EPA RSL	0.022	SCV	0.022	0.007	0.025	0.0125	0.0048
4-METHYL-2-PENTANONE	108-10-1	530	EPA RSL	0.033	SCV	0.033	0.011	0.025	0.0125	0.0059
ACETONE	67-64-1	6100	EPA RSL	0.0087	SCV	0.0087	0.0029	0.025	0.0125	0.0051
BENZENE	71-43-2	1.2	EPA RSL	0.057	EPA SQB	0.057	0.019	0.005	0.0025	0.00092
BROMOCHLOROMETHANE	74-97-5	15	EPA RSL	NC	None	15	5	0.005	0.0025	0.00091
BROMODICHLOROMETHANE	75-27-4	0.29	EPA RSL	NC	None	0.29	0.1	0.005	0.0025	0.0006
BROMOFORM	75-25-2	67	EPA RSL	0.65	SCV	0.65	0.22	0.005	0.0025	0.0007
BROMOMETHANE	74-83-9	0.68	EPA RSL	0.00137	ESV	0.00137	0.00046	0.01	0.005	0.0011
CARBON DISULFIDE	75-15-0	77	EPA RSL	0.00085	SCV	0.00085	0.00028	0.005	0.0025	0.00078
CARBON TETRACHLORIDE	56-23-5	0.65	EPA RSL	1.2	EPA SQB	0.65	0.22	0.005	0.0025	0.0013
CHLOROBENZENE	108-90-7	28	EPA RSL	0.82	EPA SQB	0.82	0.27	0.005	0.0025	0.00051
CHLOROETHANE	75-00-3	1400	EPA RSL	NC	None	1400	470	0.01	0.005	0.0013
CHLOROFORM	67-66-3	0.32	EPA RSL	0.022	SCV	0.022	0.007	0.005	0.0025	0.00035
CHLOROMETHANE	74-87-3	11	EPA RSL	NC	None	11	3.7	0.01	0.005	0.0014
CIS-1,2- DICHLOROETHENE	156-59-2	16	EPA RSL	0.4	SCV	0.4	0.13	0.005	0.0025	0.00091
CIS-1,3- DICHLOROPROPENE	10061-01-5	1.8 ³	EPA RSL	0.000051	SCV	0.000051	0.000017	0.005	0.0025	0.00072
CYCLOHEXANE	110-82-7	650	EPA RSL	NC	None	650	220	0.005	0.0025	0.0014
DIBROMOCHLOROMETHANE	124-48-1	0.73	EPA RSL	NC	None	0.73	0.24	0.005	0.0025	0.001
DICHLORODIFLUOROMETHANE	75-71-8	8.7	EPA RSL	NC	None	8.7	2.9	0.01	0.005	0.00092
ETHYLBENZENE	100-41-4	5.8	EPA RSL	3.6	EPA SQB	3.6	1.2	0.005	0.0025	0.00065
ISOPROPYLBENZENE	98-82-8	190	EPA RSL	NC	None	190	63	0.005	0.0025	0.00092
METHYL ACETATE	79-20-9	7800	EPA RSL	NC	None	7800	2600	0.005	0.003	0.0027
METHYL TERT-BUTYL ETHER	1634-04-4	47	EPA RSL	NC	None	47	16	0.005	0.0025	0.00011
METHYLCYCLOHEXANE	108-87-2	NC	None	NC	None	NC	NC	0.005	0.0025	0.00096
METHYLENE CHLORIDE	75-09-2	35	EPA RSL	0.37	SCV	0.37	0.12	0.025	0.0125	0.0079
STYRENE	100-42-5	600	EPA RSL	0.254	ESV	0.254	0.085	0.005	0.0025	0.00051
TETRACHLOROETHENE	127-18-4	8.1	EPA RSL	0.53	EPA SQB	0.53	0.18	0.005	0.0025	0.0012
TOLUENE	108-88-3	490	EPA RSL	0.67	EPA SQB	0.67	0.22	0.005	0.0025	0.0014
O-XYLENE	95-47-6	65	EPA RSL	NC	None	65	22	0.005	0.0025	0.0013
m,p-XYLENE	108-38-3	55	EPA RSL	NC	None	55	18	0.01	0.005	0.0017
TOTAL XYLENES	1330-20-7	58	EPA RSL	NC	None	58	19	15	7.5	1.3
TRANS-1,2- DICHLOROETHENE	156-60-5	160	EPA RSL	0.4	SCV	0.4	0.13	0.005	0.0025	0.00071
TRANS-1,3-DICHLOROPROPENE	10061-02-6	1.8 ³	EPA RSL	0.000051	SCV	0.000051	0.000017	0.005	0.0025	0.00086

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
TRICHLOROETHENE	79-01-6	0.41	EPA RSL	1.6	EPA SQB	0.41	0.14	0.005	0.0025	0.00059
TRICHLOROFLUOROMETHANE	75-69-4	73	EPA RSL	NC	None	73	24	0.01	0.005	0.00091
VINYL CHLORIDE	75-01-4	0.059	EPA RSL	0.202	ESV	0.059	0.02	0.01	0.005	0.00087
TARGET COMPOUND LIST SEMI-VOLATION	LE ORGANIC COM	POUNDS								
1,1'-BIPHENYL	92-52-4	4.7	EPA RSL	1.1	EPA SQB	1.1	0.37	0.33	0.248	0.073
1,4-DIOXANE* (SIM)	123-91-1	5.3	EPA RSL	0.119	ESV	0.119	0.04	0.1	0.05	0.0011
1,2,4,5-TETRACHLOROBENZENE	95-94-3	1.8	EPA RSL	1.252	ESV	1.252	0.42	0.33	0.248	0.135
2,2-OXYBIS(1-CHLOROPROPANE)	108-60-1	4.9	EPA RSL	NC	None	4.9	1.6	0.33	0.248	0.089
2,3,4,6-TETRACHLOROPHENOL	58-90-2	180	EPA RSL	0.129	ESV	0.129	0.043	0.33	0.248	0.14
2,4,5-TRICHLOROPHENOL	95-95-4	620	EPA RSL	0.003	NOAA	0.003	0.001	0.82	0.615	0.155
2,4,6-TRICHLOROPHENOL	88-06-2	6.2	EPA RSL	0.006	NOAA	0.006	0.002	0.33	0.248	0.155
2,4-DICHLOROPHENOL	120-83-2	18	EPA RSL	0.0002083	NOAA	0.0002083	0.00007	0.33	0.248	0.15
2,4-DIMETHYLPHENOL	105-67-9	120	EPA RSL	0.018	NOAA	0.018	0.006	0.33	0.248	0.165
2,4-DINITROPHENOL	51-28-5	12	EPA RSL	0.00621	ESV	0.00621	0.0021	0.82	0.615	0.377
2,4-DINITROTOLUENE	121-14-2	1.7	EPA RSL	0.0144	ESV	0.0144	0.0048	0.33	0.248	0.085
2,6-DINITROTOLUENE	606-20-2	0.36	EPA RSL	0.0398	ESV	0.0398	0.013	0.33	0.248	0.079
2-CHLORONAPHTHALENE	91-58-7	630	EPA RSL	0.417	ESV	0.417	0.14	0.33	0.248	0.087
2-CHLOROPHENOL	95-57-8	39	EPA RSL	0.000333	NOAA	0.000333	0.00011	0.33	0.248	0.164
2-METHYLNAPHTHALENE* (SIM)	91-57-6	23	EPA RSL	0.021	NOAA	0.021	0.007	0.02	0.01	0.0017
2-METHYLPHENOL	95-48-7	310	EPA RSL	0.008	NOAA	0.008	0.0027	0.33	0.248	0.2
2-NITROANILINE	88-74-4	61	EPA RSL	NC	None	61	30	0.82	0.615	0.075
2-NITROPHENOL	88-75-5	NC	None	NC	None	NC	NC	0.33	0.248	0.167
3,3'-DICHLOROBENZIDINE	91-94-1	1.2	EPA RSL	0.127	ESV	0.127	0.042	0.33	0.248	0.114
3-NITROANILINE	99-09-2	25 ⁴	EPA RSL	NC	None	25	8.3	0.82	0.615	0.094
4,6-DINITRO-2-METHYLPHENOL	534-52-1	0.49	EPA RSL	0.104	ESV	0.104	0.035	0.82	0.615	0.337
4-BROMOPHENYL-PHENYLETHER	101-55-3	NC	None	1.3	EPA SQB	1.3	0.43	0.33	0.248	0.085
4-CHLORO-3-METHYLPHENOL	59-50-7	620	EPA RSL	0.388	ESV	0.388	0.13	0.33	0.248	0.166
4-CHLOROANILINE	106-47-8	2.7	EPA RSL	0.146	ESV	0.146	0.05	0.33	0.248	0.119
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NC	None	NC	None	NC	NC	0.33	0.248	0.078
4-METHYLPHENOL	106-44-5	620	EPA RSL	0.1	NOAA	0.1	0.03	0.33	0.248	0.187
4-NITROANILINE	100-01-6	25	EPA RSL	NC	None	25	8.3	0.82	0.615	0.134
4-NITROPHENOL	100-02-7	NC	None	0.0133	ESV	0.0133	0.004	0.82	0.615	0.309
ACENAPHTHENE* (SIM)	83-32-9	350	EPA RSL	0.016	EPA SQB	0.016	0.005	0.02	0.01	0.0015
ACENAPHTHYLENE* (SIM)	208-96-8	350 ⁵	EPA RSL	0.00587	NOAA	0.00587	0.002	0.02	0.01	0.0012
ANTHRACENE* (SIM)	120-12-7	1700	EPA RSL	0.0572	TEC	0.0572	0.019	0.02	0.01	0.0012
ATRAZINE	1912-24-9	2.3	EPA RSL	NC	None	2.3	0.77	0.33	0.248	0.091
BENZALDEHYDE	100-52-7	780	EPA RSL	NC	None	780	260	0.33	0.248	0.12
BENZO (A) ANTHRACENE* (SIM)	56-55-3	0.15	EPA RSL	0.108	TEC	0.108	0.036	0.02	0.01	0.0019
- (,						+		_	+	
BENZO (A) PYRENE* (SIM)	50-32-8	0.015	EPA RSL	0.15	TEC	0.015	0.005	0.02	0.01	0.0033

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
BENZO (G,H,I) PERYLENE* (SIM)	191-24-2	170 ⁶	EPA RSL	0.17	LEL	0.17	0.057	0.02	0.01	0.002
BENZO (K) FLUOROANTHENE* (SIM)	207-08-9	1.5	EPA RSL	0.24	LEL	0.24	0.08	0.02	0.01	0.0031
BIS(2-CHLOROETHOXY) METHANE	111-91-1	18	EPA RSL	NC	None	18	6	0.33	0.248	0.096
BIS-(2-CHLOROETHYL) ETHER	111-44-4	0.23	EPA RSL	3.52	ESV	0.23	0.08	0.33	0.248	0.081
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	38	EPA RSL	0.75	NOAA	0.75	0.25	0.33	0.248	0.098
BUTYLBENZYLPHTHALATE	85-68-7	280	EPA RSL	11	EPA SQB	11	3.7	0.33	0.248	0.093
CAPROLACTAM	105-60-2	3100	EPA RSL	NC	None	3100	1000	0.33	0.248	0.144
CARBAZOLE	86-74-8	NC	None	NC	None	NC	NC	0.33	0.248	0.111
CHRYSENE* (SIM)	218-01-9	15	EPA RSL	0.166	TEC	0.166	0.055	0.02	0.01	0.0017
DIBENZO (A,H)ANTHRACENE* (SIM)	53-70-3	0.015	EPA RSL	0.033	TEC	0.015	0.005	0.02	0.01	0.0018
DIBENZOFURAN	132-64-9	7.2	EPA RSL	2	EPA SQB	2	0.67	0.33	0.248	0.079
DIETHYLPHTHALATE	84-66-2	4900	EPA RSL	0.63	EPA SQB	0.63	0.21	0.33	0.248	0.08
DIMETHYLPHTHALATE	131-11-3	NC COO	None	0.006	NOAA	0.006	0.002	0.33	0.248	0.078
DI-N-BUTYLPHTHALATE DI-N-OCTYLPHTHALATE	84-74-2 117-84-0	620 62	EPA RSL	0.061	EPA SQB NOAA	11 0.061	3.7 0.02	0.33 0.33	0.248 0.248	0.101 0.211
FLUORANTHENE* (SIM)	206-44-0	230	EPA RSL	0.423	TEC	0.423	0.14	0.02	0.246	0.0018
FLUORENE* (SIM)	86-73-7	230	EPA RSL	0.423	TEC	0.0774	0.026	0.02	0.01	0.0018
HEXACHLOROBENZENE	118-74-1	0.33	EPA RSL	0.02	NOAA	0.02	0.0067	0.33	0.248	0.082
HEXACHLOROBUTADIENE	87-68-3	6.2	EPA RSL	0.0013	NOAA	0.0013	0.0004	0.33	0.248	0.083
HEXACHLOROCYCLOPENTADIENE	77-47-4	37	EPA RSL	0.901	ESV	0.901	0.3	0.33	0.248	0.082
HEXACHLOROETHANE	67-72-1	4.3	EPA RSL	1	EPA SQB	1	0.33	0.33	0.248	0.096
INDENO (1,2,3-CD)-PYRENE* (SIM)	193-39-5	0.15	EPA RSL	0.2	LEL	0.15	0.05	0.02	0.01	0.0019
ISOPHORONE	78-59-1	560	EPA RSL	0.432	ESV	0.432	0.144	0.33	0.248	0.075
NAPHTHALENE* (SIM)	91-20-3	3.8	EPA RSL	0.176	TEC	0.176	0.059	0.02	0.01	0.0026
NITROBENZENE	98-95-3	5.1	EPA RSL	0.021	NOAA	0.021	0.007	0.33	0.248	0.091
N-NITROSO DIPHENYLAMINE	86-30-6	110	EPA RSL	0.028	NOAA	0.028	0.009	0.33	0.248	0.219
N-NITROSO-DI-N PROPYLAMINE	621-64-7	0.076	EPA RSL	NC	None	0.076	0.025	0.33	0.248	0.083
PENTACHLOROPHENOL	87-86-5	0.99	EPA RSL	0.017	NOAA	0.017	0.006	0.82	0.615	0.237
PHENANTHRENE* (SIM)	85-01-8	170 ⁶	EPA RSL	0.204	TEC	0.204	0.068	0.02	0.01	0.0018
PHENOL	108-95-2	1800	EPA RSL	0.048	NOAA	0.048	0.016	0.33	0.248	0.156
PYRENE* (SIM)	129-00-0	170	EPA RSL	0.195	TEC	0.195	0.065	0.02	0.01	0.0021
EXPLOSIVES	1	1	T	T -					, ,	
1,3,5-TRINITROBENZENE	99-35-4	220	EPA RSL	8	Sunahara	8	2.7	0.1	0.05	0.0067
1,3-DINITROBENZENE	99-65-0	0.62	EPA RSL	0.00861	ESV	0.00861	0.003	0.1	0.05	0.0062
2,4-DINITROTOLUENE	121-14-2	1.7	EPA RSL	0.29	LANL	0.29	0.1	0.1	0.05	0.015
2,6-DINITROTOLUENE	606-20-2	0.36	EPA RSL	0.5	Sunahara	0.36	0.12	0.1	0.05	0.027
NITROBENZENE	98-95-3	5.1	EPA RSL	0.145	ESV	0.145	0.05	0.1	0.05	0.022
2,4,6-TRINITROTOLUENE	118-96-7	3.6	EPA RSL	4	Sunahara	3.6	1.2	0.1	0.05	0.0067
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	15	EPA RSL	23	Sunahara	15	5	0.1	0.05	0.021

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
2-NITROTOLUENE	88-72-2	3.2	EPA RSL	4.06	Region 3 toluene)	3.2	1.1	0.1	0.05	0.012
3-NITROTOLUENE	99-08-1	0.62	EPA RSL	4.06	Region 3	0.62	0.21	0.1	0.05	0.079
3,5-DINITROANILINE	618-87-1	NC	None	NA	NA	NC	NC	0.1	0.05	0.0035
4-AMINO-2,6-DINITROTOLUENE	19406-51-0	15	EPA RSL	23	Sunahara	15	5	0.1	0.05	0.017
4-NITROTOLUENE	99-99-0	25	EPA RSL	4.06	Region 3	4.06	1.4	0.1	0.05	0.027
HMX	2691-41-0	380	EPA RSL	126	Sunahara	126	42	0.1	0.05	0.0086
TETRYL	479-45-8	12	EPA RSL	0.1	Sunahara	0.1	0.03	0.1	0.05	0.0054
RDX	121-82-4	6.0	EPA RSL	102	Sunahara	6.0	2	0.1	0.05	0.0068
PETN	78-11-5	12	EPA RSL	NA	NA	12	4	0.8	0.4	0.108
NITROGLYCERIN	55-63-0	0.62	EPA RSL	NA	NA	0.62	0.21	0.8	0.4	0.108
TARGET COMPOUND LIST PESTICIDES					Final Volume = 2 mls.		0.21	0.6	0.4	0.124
4,4'-DDD	72-54-8	2.2	EPA RSL	0.00488	TEC	0.00488	0.0016	0.00066	0.00033	0.00004
4,4'-DDE	72-55-9	1.6	EPA RSL					0.00066	0.00033	0.00004
4,4'-DDT	50-29-3	1.9	EPA RSL	0.00316 0.00416	TEC TEC	0.00316 0.00416	0.0011 0.0014	0.00066	0.00033	0.000062
ALDRIN	309-00-2	0.031	EPA RSL	0.00410	LEL	0.00410	0.0014	0.00034	0.00017	0.000056
ALPHA-BHC	319-84-6	0.085	EPA RSL	0.002	LEL	0.002	0.0007	0.00034	0.00017	0.000068
ALPHA-CHLORDANE	5103-71-9	1.8 7	EPA RSL	0.00324	TEC	0.00324	0.0011	0.00034	0.00017	0.000042
BETA-BHC	319-85-7	0.30	EPA RSL	0.005	LEL	0.005	0.0017	0.00034	0.00017	0.000066
DELTA-BHC	319-86-8	NC	EPA RSL	0.12	SCV	0.12	0.04	0.00034	0.00017	0.000064
DIELDRIN	60-57-1	0.033	EPA RSL	0.0019	TEC	0.0019	0.00063	0.00066	0.00033	0.000044
ENDOSULFAN I	959-98-8	37 ⁸	EPA RSL	0.0029	EPA SQB	0.0029	0.00097	0.000340	0.00017	0.00024/5
ENDOSULFAN II	33213-65-9	37 ⁸	EPA RSL	0.014	EPA SQB	0.014	0.00467	0.000660	0.00033	0.000068
ENDOSULFAN SULFATE	1031-07-8	37 ⁸	EPA RSL	0.0346	ESV	0.0346	0.01153	0.000660	0.00033	0.000116
ENDRIN	72-20-8	1.8	EPA RSL	0.00222	TEC	0.00222	0.00074	0.000660	0.00033	0.00017
ENDRIN ALDEHYDE	7421-93-4	1.8 9	EPA RSL	0.48	ESV	0.48	0.16	0.000660	0.00033	0.000098
ENDRIN KETONE	53494-70-5	1.8 ⁹	EPA RSL	NC	NC	1.8	0.6	0.000660	0.00033	0.00008
GAMMA-BHC (LINDANE)	58-89-9	0.56	EPA RSL	0.00237	TEC	0.00237	0.00079	0.000340	0.00017	0.000046
GAMMA-CHLORDANE	5103-74-2	1.8 7	EPA RSL	0.00324	TEC	0.00324	0.0011	0.00034	0.00017	0.000046
HEPTACHLOR	76-44-8	0.12	EPA RSL	0.01	NOAA	0.01	0.0033	0.00034	0.00017	0.000058
HEPTACHLOR EPOXIDE	1024-57-3	0.059	EPA RSL	0.00247	TEC	0.00247	0.00082	0.00034000	0.00017	0.000044
METHOXYCHLOR	72-43-5	31	EPA RSL	0.019	EPA SQB	0.019	0.0063	0.0034	0.0017	0.0001
TARGET COMPOUND LIST BOLVOULORIN	8001-35-2	0.48	EPA RSL	0.028	EPA SQB	0.028	0.0093	0.0066	0.0032	0.0014
TARGET COMPOUND LIST POLYCHLORING AROCLOR-1016	12674-11-2	0.40	1					0.0034	0.0017	0.0012
AROCLOR-1016 AROCLOR-1221	12674-11-2	0.40	EPA RSL EPA RSL	0.0598	TEC TEC	0.0598	0.02	0.0034	0.0017	0.0012
AROCLOR-1221 AROCLOR-1232	11141-16-5	0.15	EPA RSL	0.0598 0.0598	TEC	0.0598 0.0598	0.02	0.0034	0.0017	0.00136
AROCLOR-1232 AROCLOR-1242	53469-21-9	0.13	EPA RSL	0.0598	TEC	0.0598	0.02	0.0034	0.002	0.00100
, 11.00LOIN 1272	00 1 00 21-0	0.27	LIANOL	0.0580	TEU	0.0580	0.02	0.0034	0.0017	0.00122

Chemical	CAS No.	Human Health PSL (mg/kg)	Human Health PSL Reference	Ecological PSL (mg/kg)	Ecological PSL Reference	Minimum PSL (mg/kg)	PQLG (mg/kg)	Katahdin LOQ (mg/kg)	Katahdin LOD (mg/kg)	Katahdin DL (mg/kg)
AROCLOR-1254	11097-69-1	0.11	EPA RSL	0.0598	TEC	0.0598	0.02	0.0034	0.0017	0.00094
AROCLOR-1260	11096-82-5	0.24	EPA RSL	0.0598	TEC	0.0598	0.02	0.0034	0.0017	0.0012
AROCLOR-1262	37324-23-5	NC	EPA RSL	0.023	EPA SQB	0.023	0.008	0.0034	0.0017	0.0005
AROCLOR-1268	11100-14-4	NC	EPA RSL	0.0598	TEC	0.0598	0.02	0.0034	0.0017	0.0005
Petroleum Hydrocarbon Fraction (EPH/VPH)									
C5-C8 aliphatics (VPH)		1,400	MEDEP	NC	None	1,400	470	25	19	12.5
C9-C12 Aliphatics(VPH)		2,700	MEDEP	NC	None	2,700	900	25	19	12.5
C9-C18 Aliphatics (EPH)		2,700	MEDEP	NC	None	2,700	900	20	15	10
C19-C36 Aliphatics (EPH)		10,000 ¹⁰	MEDEP	NC	None	10,000 ¹⁰	3300	20	15	10
C9-C10 Aromatics(VPH)		75	MEDEP-L	NC	None	75	25	25	19	12.5
C11-C22 Aromatics (EPH)		460	MEDEP-L	NC	None	460	150	20	15	10

Bolded rows indicate that either the human health or ecological PSL is between the laboratory LOQ and LOD. The Partnering Team has agreed to accept these data for decision making if results less than the LOQ are "J" qualified and if the results are discussed in the RI.

Shaded and bolded rows indicate that either the human health or ecological PSL is less than the LOD. In cases where the LOD is greater than the PSL and the contaminant was not detected, the contaminant will not be retained as a COPC. However, the uncertainty associated with this decision will be discussed in the risk assessment section. Moreover, a discussion regarding the likelihood of the presence of that contaminant (e.g., based on historical site uses) will be included in the risk assessment section.

- ** These metals will be analyzed by SW-846 6020.
- * (SIM) Indicates that these compounds will be reported from a Selected Ion Monitoring (SIM) analysis.

Pesticide and PCB analyses will be concentrated to a 2 mL final volume to achieve lower detection limits.

CAS = Chemical Abstract Service.

PQLG = Project Quantitation Limit Goal.

NC = No criterion.

RSL = Regional Screening Levels

Note: At the time of data evaluation, the most recent screening criteria will be used for the HHRA and ERA.

Human Health PSL References

EPA RSL: USEPA Regions 3, 6, and 9 Regional Screening Levels for Soil, Residential (USEPA, May 2014). EPA RSLs for non-carcinogens in residential soil are adjusted by dividing by 10, equivalent to hazard quotients of 0.1. The EPA RSLs for carcinogens in residential soil are not adjusted and are equivalent to ILCRs of 1E-6

MEDEP Table 4 - Tier 1 Direct Contact Soil Remediation Guidelines for Smaller Petroleum Contamination Sites (MEDEP, 2014) MEDEP-L Table 3 - Tier 1 Soil Remediation Guideline Based on Petroleum Leaching to Ground Water (MEDEP, 2014).

Footnotes

- 1 Hexavalent chromium analysis will be conducted by ALS. ALS LOQs, LODs, and DLs are provided.
- 2 The value presented is for vanadium and compounds.
- 3 The value presented is for 1.3-dichloropropene.
- 4 The value presented is for 4-nitroaniline.
- 5 The value presented is for acenaphthene.
- 6 The value presented is for pyrene.
- 7 The value presented is for chlordane.
- 8 The value presented is for endosulfan.
- 9 The value presented is for endrin.
- 10 Value is greater than ceiling value of 10,000 mg/kg; therefore, the ceiling value is used as the human health PSL for this parameter.

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date: September 2014 Worksheet 15 Page 79 of 178

Ecological PSL References

Sources Selected in the Following Order of Preference (excluding explosives):

TEC (MacDonald, et al 2000)
LEL (Persaud, et al 1993)
EPA SQB (USEPA, 1996)
NOAA (Buchman, 2008) (freshwater value selected before marine value)
SCV (Jones, et al 1997)
ESV (USEPA, 2003)
LANL (LANL, 2012)

Sources for Explosives Selected in the Following Order of Preference:

LANL (LANL, 2012) Sunahara (Suhahara, et al., 2009) ESV (USEPA, 2003) NOAA (Buchman, 2008) Region 3 (USEPA, 2006)

SAP Worksheet #15c -- Reference Limits and Evaluation Table – Surface Water

Project screening-level support documentation is provided in Appendix B.

(UFP-QAPP Manual Section 2.8.1)

Chemical CAS No. Human Health PSL (μg/L) Human Health PSL (μg/L) Ecological PSL Reference Minimum PSL (μg/L) PQLG (μg/L) Katal LO (μg/L) TARGET ANALYTE LIST METALS ALUMINUM** 7429-90-5 2000 Tapwater RSL 87 MEDEP 87 29 30 ANTIMONY** 7440-36-0 0.78 Tapwater RSL 7440-38-2 30 Region 3 0.78 0.26 1 ARSENIC** 7440-38-2 0.052 Tapwater RSL 7440-38-3 150 MEDEP 0.052 0.017 5 BARIUM*** 7440-39-3 380 Tapwater RSL 7440-78-78 4 Region 3 4 1.3 2	PQ (μ //L) (μ	40 0.5	Katahdin DL (µg/L) 4.4 0.054
ALUMINUM** 7429-90-5 2000 Tapwater RSL 87 MEDEP 87 29 30 ANTIMONY** 7440-36-0 0.78 Tapwater RSL 30 Region 3 0.78 0.26 1 ARSENIC** 7440-38-2 0.052 Tapwater RSL 150 MEDEP 0.052 0.017 5 PARILIM** 7440-30-3 380 Tapwater Tapwater 4 Paging 3 4 1.3 2	5	0.5	0.054
ANTIMONY** 7440-36-0 0.78 Tapwater RSL RSL 30 Region 3 0.78 0.29 30 ARSENIC** 7440-38-2 0.052 Tapwater RSL	5	0.5	0.054
ARSENIC** 7440-36-0 0.76 RSL So Region 3 0.76 0.26 1 ARSENIC** 7440-38-2 0.052 Tapwater RSL Tapwater RSL	2		
RSL 130 MEDEP 0.032 0.017 3 RAPHIM** 7440-38-2 0.032 RSL 130 MEDEP 0.032 0.017 3	2	4	2.2
		1	0.27
BERYLLIUM** 7440-41-7 2.5 Tapwater RSL 0.66 Region 3 0.66 0.22 1		0.2	0.034
CADMIUM** 7440-43-9 0.92 Tapwater RSL 0.08 MEDEP 0.08 0.03 1		0.2	0.03
CALCIUM 7440-70-2 NC None 116000 Region 3 116000 38700 10	0	80	20
CHROMIUM** 7440-47-3 2,200 Tapwater RSL 23.1 MEDEP 23.1 7.7 4		3	0.22
HEXAVALENT CHROMIUM 18540-29-9 0.035 Tapwater RSL 11 MEDEP 0.035 0.012 27		10 ¹	10 ¹
COBALT** 7440-48-4 0.6 Tapwater RSL 23 Region 3 0.6 0.2 1		0.3	0.06
COPPER** 7440-50-8 80 Tapwater RSL 2.36 MEDEP 2.36 0.79 3	,	2	0.18
IRON** 7439-89-6 1400 Tapwater RSL 1000 MEDEP 1000 300 10	Ю.	60	13
LEAD** 7439-92-1 15 MCL 0.41 MEDEP 0.41 0.14 1		0.5	0.074
MERCURY 7487-94-7 0.063 Tapwater RSL 0.77 NRWQC 10 0.063 0.021 0.21		0.1	0.013
MAGNESIUM** 7439-95-4 NC None 82000 Region 3 82000 27000 10	0	80	7.8
MANGANESE** 7439-96-5 43 Tapwater RSL 120 Region 3 43 14 2		1	0.35
NICKEL** 7440-02-0 39 Tapwater RSL 13.4 MEDEP 13.4 4.5 2		1.2	0.15
POTASSIUM 7440-09-7 NC None 53000 Region 3 53000 18000 100)0	500	41
SELENIUM** 7782-49-2 10 Tapwater RSL 5 MEDEP 5 1.7 5	;	3	0.19
SILVER** 7440-22-4 9.4 Tapwater RSL 3.2 Region 3 3.2 1.1 1		0.4	0.05
SODIUM 7440-23-5 NC None 680000 Region 3 680000 230000 100)0	500	24
THALLIUM** 7440-28-0 0.020 Tapwater RSL 0.8 Region 3 0.02 0.01 1		0.4	0.06
VANADIUM** 7440-62-2 8.6 ² Tapwater RSL 20 Region 3 8.6 2.9 5	i	4	0.51

Chemical	CAS No.	Human Health PSL (µg/L)	Human Health PSL Reference	Ecological PSL (µg/L)	Ecological PSL Reference	Minimum PSL (µg/L)	PQLG (µg/L)	Katahdin LOQ (µg/L)	Katahdin LOD (µg/L g)	Katahdin DL (µg/L)
ZINC**	7440-66-6	600	Tapwater RSL	30.6	MEDEP	30.6	10.2	10	8	3.9
TARGET COMPOUND LIST VOLATILE ORG	ANIC COMPOUNI	DS						_		
1,1- DICHLOROETHANE	75-34-3	2.7	Tapwater RSL	47	Region 3	2.7	0.9	1	0.5	0.21
1,1,1-TRICHLOROETHANE	71-55-6	800	Tapwater RSL	11	Region 3	11	3.7	1	0.5	0.2
1,1,2- TRICHLOROETHANE	79-00-5	0.041	Tapwater RSL	1200	Region 3	0.041	0.014	1	0.5	0.33
1,1,2,2- TETRACHLORETHANE	79-34-5	0.076	Tapwater RSL	610	Region 3	0.076	0.025	1	0.5	0.38
1,1,2-TRICHLORO-1,2,2-TRIFLUORO- ETHANE	76-13-1	5500	Tapwater RSL	NC	None	5500	1800	1	0.5	0.31
1,1-DICHLOROETHENE	75-35-4	28	Tapwater RSL	25	Region 3	25	8.3	1	0.5	0.35
1,2- DICHLOROBENZENE	95-50-1	30	Tapwater RSL	0.7	Region 3	0.7	0.23	1	0.5	0.15
1,2- DICHLOROETHANE	107-06-2	0.17	Tapwater RSL	100	Region 3	0.17	0.06	1	0.5	0.2
1,2,3-TRICHLOROBENZENE	87-61-6	0.70	Tapwater RSL	8	Region 3	0.7	0.23	1	0.5	0.27
1,2,4-TRICHLOROBENZENE	120-82-1	0.40	Tapwater RSL	24	Region 3	0.4	0.13	1	0.5	0.37
1,2-DIBROMO-3-CHLOROPROPANE (by 504)	96-12-8	0.00033	Tapwater RSL	NC	None	0.00033	0.00011	0.05	0.03	0.0063
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.00033	Tapwater RSL	NC	None	0.00033	0.00011	1	0.75	0.50
1,2-DIBROMOETHANE (by 504)	106-93-4	0.0075	Tapwater RSL	NC	None	0.0075	0.0025	0.1	0.03	0.0073
1,2-DICHLOROPROPANE	78-87-5	0.44	Tapwater RSL	5700	NOAA	0.44	0.15	1	0.5	0.25
1,3-DICHLOROBENZENE	541-73-1	NC	None	150	Region 3	150	50	1	0.5	0.26
1,4- DICHLOROBENZENE	106-46-7	0.48	Tapwater RSL	26	Region 3	0.48	0.16	1	0.5	0.24
2-BUTANONE	78-93-3	560	Tapwater RSL	14000	Region 3	560	190	5	2.5	1.31
2-HEXANONE	591-78-6	3.8	Tapwater RSL	99	Region 3	3.8	1.3	5	2.5	1.7
4-METHYL-2-PENTANONE	108-10-1	120	Tapwater RSL	170	Region 3	120	40	5	2.5	1.32
ACETONE	67-64-1	1400	Tapwater RSL	1500	Region 3	1400	470	5	2.5	2.21
BENZENE	71-43-2	0.45	Tapwater RSL	370	Region 3	0.45	0.15	1	0.5	0.26
BROMOCHLOROMETHANE	74-97-5	8.3	Tapwater RSL	NC	None	8.3	2.8	1	0.5	0.21
BROMODICHLOROMETHANE	75-27-4	0.13	Tapwater RSL	1100	NOAA 11	0.13	0.04	1	0.5	0.33

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BROMOFORM	75-25-2	9.2	Tapwater RSL	320	Region 3	9.2	3.1	1	0.5	0.23
BROMOMETHANE	74-83-9	0.75	Tapwater RSL	NC	None	0.75	0.25	2	1	0.49
CARBON DISULFIDE	75-15-0	81	Tapwater RSL	0.92	Region 3	0.92	0.31	1	0.5	0.25
CARBON TETRACHLORIDE	56-23-5	0.45	Tapwater RSL	13.3	Region 3	0.45	0.15	1	0.5	0.22
CHLOROBENZENE	108-90-7	7.8	Tapwater RSL	1.3	Region 3	1.3	0.43	1	0.5	0.22
CHLOROETHANE	75-00-3	2100	Tapwater RSL	NC	None	2100	700	2	1	0.55
CHLOROFORM	67-66-3	0.22	Tapwater RSL	1.8	Region 3	0.22	0.07	1	0.5	0.32
CHLOROMETHANE	74-87-3	19	Tapwater RSL	NC	None	19	6.3	2	1	0.36
CIS-1,2- DICHLOROETHENE	156-59-2	3.6	Tapwater RSL	590	Region 3	3.6	1.2	1	0.5	0.21
CIS-1,3- DICHLOROPROPENE	10061-01-5	0.47 ³	Tapwater RSL	0.055	Region 2	0.055	0.18	1	0.5	0.19
CYCLOHEXANE	110-82-7	1300	Tapwater RSL	NC	None	1300	430	1	0.5	0.31
DIBROMOCHLOROMETHANE	124-48-1	0.17	Tapwater RSL	1100	NOAA 11	0.17	0.06	1	0.5	0.3
DICHLORODIFLUOROMETHANE	75-71-8	20	Tapwater RSL	NC	None	20	6.7	2	1	0.24
ETHYLBENZENE	100-41-4	1.5	Tapwater RSL	90	Region 3	1.5	0.5	1	0.5	0.21
ISOPROPYLBENZENE	98-82-8	45	Tapwater RSL	2.6	Region 3	2.6	0.87	1	0.5	0.23
METHYL ACETATE	79-20-9	2000	Tapwater RSL	NC	None	2000	670	1	0.75	0.53
METHYL TERT-BUTYL ETHER	1634-04-4	14	Tapwater RSL	11070	Region 3	14	4.7	1	0.5	0.36
METHYLCYCLOHEXANE	108-87-2	NC	None	NC	None	NC	NC	1	0.5	0.3
METHYLENE CHLORIDE	75-09-2	11	Tapwater RSL	98.1	Region 3	11	3.7	5	2.5	1.13
STYRENE	100-42-5	120	Tapwater RSL	72	Region 3	72	24	1	0.5	0.23
TETRACHLOROETHENE	127-18-4	4.1	Tapwater RSL	111	Region 3	4.1	1.4	1	0.5	0.4
TOLUENE	108-88-3	110	Tapwater RSL	2	Region 3	2	0.67	1	0.5	0.27
O-XYLENE	95-47-6	19	Tapwater RSL	350	NOAA	19	6.3	1	0.5	0.25
m,p-XYLENE	108-38-3	19	Tapwater RSL	1.8	Region 3	1.8	0.6	1	0.5	0.59

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TOTAL XYLENES	1330-20-7	19	Tapwater RSL	13	Region 3	13	4.3	3	1.5	0.25
TRANS-1,2- DICHLOROETHENE	156-60-5	36	Tapwater RSL	970	Region 3	36	12	1	0.5	0.25
TRANS-1,3-DICHLOROPROPENE	10061-02-6	0.47 4	Tapwater RSL	0.055	Region 3	0.055	0.018	1	0.5	0.2
TRICHLOROETHENE	79-01-6	0.28	Tapwater RSL	21	Region 3	0.25	0.08	1	0.5	0.28
TRICHLOROFLUOROMETHANE	75-69-4	110	Tapwater RSL	NC	None	110	37	1	0.5	0.24
VINYL CHLORIDE	75-01-4	0.019	Tapwater RSL	930	Region 3	0.19	0.06	2	1	0.25
TARGET COMPOUND LIST SEMI-VOLATILE	ORGANIC COM	POUNDS	NOL							
1,1'-BIPHENYL* (SIM)	92-52-4	0.083	Tapwater RSL	14	Region 3	0.083	0.028	0.2	0.1	0.065
1,4-DIOXANE* (SIM)	123-91-1	0.78	Tapwater RSL	NC	None	0.78	0.26	1	0.5	0.029
1,2,4,5-TETRACHLOROBENZENE* (SIM)	95-94-3	0.17	Tapwater RSL	3	Region 3	0.17	0.06	0.2	0.1	0.037
2,2-OXYBIS(1-CHLOROPROPANE)* (SIM)	108-60-1	0.36	Tapwater RSL	NC	None	0.36	0.12	0.2	0.15	0.12
2,3,4,6-TETRACHLOROPHENOL* (SIM)	58-90-2	24	Tapwater RSL	1.2	Region 3	1.2	0.4	1	0.5	0.071
2,4,5-TRICHLOROPHENOL	95-95-4	120	Tapwater RSL	NC	None	120	40	25	18.8	3.6
2,4,6-TRICHLOROPHENOL* (SIM)	88-06-2	1.6	Tapwater RSL	4.9	Region 3	1.6	0.53	1	0.5	0.12
2,4-DICHLOROPHENOL* (SIM)	120-83-2	4.6	Tapwater RSL	11	Region 3	4.6	1.5	2	1	0.89
2,4-DIMETHYLPHENOL	105-67-9	36	Tapwater RSL	100	NOAA	36	12	10	7.5	4.4
2,4-DINITROPHENOL* (SIM)	51-28-5	3.9	Tapwater RSL	19	NOAA	3.9	1.3	1	0.5	0.24
2,4-DINITROTOLUENE* (SIM)	121-14-2	0.24	Tapwater RSL	44	Region 3	0.24	0.08	0.2	0.1	0.035
2,6-DINITROTOLUENE* (SIM)	606-20-2	0.048	Tapwater RSL	81	Region 3	0.048	0.016	0.2	0.1	0.07
2-CHLORONAPHTHALENE* (SIM)	91-58-7	75	Tapwater RSL	0.396	NOAA	0.396	0.132	0.2	0.1	0.072
2-CHLOROPHENOL* (SIM)	95-57-8	9.1	Tapwater RSL	24	Region 3	9.1	3	1	0.5	0.28
2-METHYLNAPHTHALENE* (SIM)	91-57-6	3.6	Tapwater RSL	4.7	Region 3	3.6	1.2	0.2	0.1	0.077
2-METHYLPHENOL* (SIM)	95-48-7	93	Tapwater RSL	13	Region 3	13	4.3	1	0.5	0.20
2-NITROANILINE* (SIM)	88-74-4	19	Tapwater RSL	NC	None	19	6.3	0.2	0.15	0.12
2-NITROPHENOL	88-75-5	NC	None	1920	Region 3	1920	640	10	7.5	2.7

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3,3'-DICHLOROBENZIDINE* (SIM)	91-94-1	0.12	Tapwater RSL	4.5	Region 3	0.12	0.04	0.2	0.1	0.056
3-NITROANILINE* (SIM)	99-09-2	3.8 4	Tapwater RSL	NC	None	3.8	1.3	0.2	0.1	0.076
4,6-DINITRO-2-METHYLPHENOL* (SIM)	534-52-1	0.15	Tapwater RSL	NC	None	0.15	0.05	1	0.75	0.5
4-BROMOPHENYL-PHENYLETHER* (SIM)	101-55-3	NC	None	1.5	Region 3	1.5	0.5	0.2	0.1	0.057
4-CHLORO-3-METHYLPHENOL	59-50-7	140	Tapwater RSL	NC	None	140	47	10	7.5	3.6
4-CHLOROANILINE* (SIM)	106-47-8	0.36	Tapwater RSL	232	Region 3	0.36	0.12	3	1.5	1.4
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NC	None	NC	None	NC	NC	10	7.5	2.2
4-METHYLPHENOL	106-44-5	190	Tapwater RSL	543	Region 3	190	63	10	7.5	5.6
4-NITROANILINE* (SIM)	100-01-6	3.8	Tapwater RSL	NC	None	3.8	1.3	0.2	0.1	0.065
4-NITROPHENOL	100-02-7	NC	None	60	Region 3	60	20	25	18.8	1.8
ACENAPHTHENE* (SIM)	83-32-9	53	Tapwater RSL	5.8	Region 3	5.8	1.9	0.2	0.1	0.064
ACENAPHTHYLENE	208-96-8	53 ⁵	Tapwater RSL	4840	NOAA	53	18	10	7.5	1.5
ANTHRACENE*(SIM)	120-12-7	180	Tapwater RSL	0.01	Region 3	0.01	0.003	0.2	0.1	0.044
ATRAZINE* (SIM)	1912-24-9	0.30	Tapwater RSL	1.8	Region 3	0.3	0.1	0.2	0.1	0.038
BENZALDEHYDE	100-52-7	190	Tapwater RSL	NC	None	190	63	10	7.5	1
BENZO (A) ANTHRACENE* (SIM)	56-55-3	0.034	Tapwater RSL	0.01	Region 3	0.01	0.003	0.2	0.1	0.046
BENZO (A) PYRENE* (SIM)	50-32-8	0.0034	Tapwater RSL	0.01	Region 3	0.0034	0.0011	0.2	0.1	0.066
BENZO (B) FLUOROANTHENE* (SIM)	205-99-2	0.034	Tapwater RSL	9.07	NOAA	0.034	0.011	0.2	0.1	0.089
BENZO (G,H,I) PERYLENE	191-24-2	12 ⁶	Tapwater RSL	NC	None	12	4	10	7.5	1.5
BENZO (K) FLUOROANTHENE* (SIM)	207-08-9	0.34	Tapwater RSL	NC	None	0.34	0.11	0.2	0.1	0.049
BIS(2-CHLOROETHOXY) METHANE* (SIM)	111-91-1	5.9	Tapwater RSL	100	NOAA 11	5.9	2	0.5	0.25	0.18
BIS-(2-CHLOROETHYL) ETHER* (SIM)	111-44-4	0.014	Tapwater RSL	1900	NOAA	0.014	0.005	0.2	0.1	0.041
BIS(2-ETHYLHEXYL) PHTHALATE* (SIM)	117-81-7	5.6	Tapwater RSL	16	Region 3	5.6	1.9	1	0.5	0.5
BUTYLBENZYLPHTHALATE	85-68-7	16	Tapwater RSL	19	Region 3	16	5.3	10	7.5	1.9
CAPROLACTAM	105-60-2	990	Tapwater RSL	NC	None	990	330	10	7.5	0.4

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CARBAZOLE	86-74-8	NC	None	NC	None	NC	NC	10	7.5	2.1
CHRYSENE	218-01-9	3.4	Tapwater RSL	NC	None	NC	NC	10	7.5	1.7
DIBENZO (A,H) ANTHRACENE	53-70-3	0.0034	Tapwater RSL	NC	None	NC	NC	10	7.5	1.7
DIBENZOFURAN* (SIM)	132-64-9	0.79	Tapwater RSL	3.7	Region 3	0.79	0.26	0.2	0.1	0.068
DIETHYLPHTHALATE	84-66-2	1500	Tapwater RSL	210	Region 3	210	70	10	7.5	2
DIMETHYLPHTHALATE* (SIM)	131-11-3	NC	None	3	NOAA	3	1	0.2	0.1	0.053
DI-N-BUTYLPHTHALATE	84-74-2	90	Tapwater RSL	19	Region 3	19	6.3	10	7.5	2.5
DI-N-OCTYLPHTHALATE	117-84-0	20	Tapwater RSL	22	Region 3	20	6.7	10	7.5	1.8
FLUORANTHENE* (SIM)	206-44-0	80	Tapwater RSL	0.04	Region 3	0.04	0.013	0.2	0.1	0.073
FLUORENE* (SIM)	86-73-7	29	Tapwater RSL	3	Region 3	3	1	0.2	0.1	0.061
HEXACHLOROBENZENE* (SIM)	118-74-1	0.049	Tapwater RSL	0.0003	Region 3	0.0003	0.0001	0.2	0.1	0.055
HEXACHLOROBUTADIENE* (SIM)	87-68-3	0.30	Tapwater RSL	1.3	Region 3	0.3	0.1	0.2	0.1	0.087
HEXACHLOROCYCLOPENTADIENE* (SIM)	77-47-4	3.1	Tapwater RSL	0.053	NOAA	0.053	0.018	0.2	0.1	0.067
HEXACHLOROETHANE* (SIM)	67-72-1	0.69	Tapwater RSL	12	Region 3	0.69	0.29	0.2	0.1	0.073
INDENO (1,2,3-CD)-PYRENE* (SIM)	193-39-5	0.034	Tapwater RSL	4.31	NOAA	0.034	0.011	0.2	0.1	0.052
ISOPHORONE	78-59-1	78	Tapwater RSL	920	NOAA	78	26	10	7.5	1.7
NAPHTHALENE* (SIM)	91-20-3	0.17	Tapwater RSL	1.1	Region 3	0.17	0.06	0.2	0.1	0.064
NITROBENZENE* (SIM)	98-95-3	0.14	Tapwater RSL	220	NOAA	0.14	0.05	0.2	0.15	0.13
N-NITROSO DIPHENYLAMINE* (SIM)	86-30-6	12	Tapwater RSL	210	Region 3	12	4	0.2	0.1	0.071
N-NITROSO-DI-N PROPYLAMINE	621-64-7	0.011	Tapwater RSL	NC	None	0.011	0.004	0.2	0.1	0.072
PENTACHLOROPHENOL* (SIM)	87-86-5	0.04	Tapwater RSL	6.69	MEDEP	0.04	0.013	1	0.5	0.33
PHENANTHRENE* (SIM)	85-01-8	12 ⁶	Tapwater RSL	0.4	Region 3	0.4	0.13	0.2	0.1	0.051
PHENOL* (SIM)	108-95-2	580	Tapwater RSL	4	Region 3	4	1.3	1	0.5	0.12
PYRENE* (SIM)	129-00-0	12	Tapwater RSL	0.02	Region 3	0.02	0.007	0.2	0.1	0.059

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EXPLOSIVES										
1,3,5-Trinitrobenzene	99-35-4	59	Tapwater RSL	NC	None	59	20	0.25	0.125	0.04
1,3-Dinitrobenzene	99-65-0	0.20	Tapwater RSL	NC	None	0.2	0.07	0.25	0.125	0.045
2,4-Dinitrotoluene	121-14-2	0.24	Tapwater RSL	44	Region 3	0.24	0.08	0.25	0.125	0.052
2,6-Dinitrotoluene	606-20-2	0.048	Tapwater RSL	81	Region 3	0.048	0.016	0.25	0.125	0.056
Nitrobenzene	98-95-3	0.14	Tapwater RSL	220	NOAA	0.14	0.05	0.25	0.125	0.071
2,4,6-Trinitrotoluene	118-96-7	0.98	Tapwater RSL	100	Region 3	0.98	0.033	0.25	0.125	0.064
2-Amino-4,6-Dinitrotoluene	35572-78-2	3.9	Tapwater RSL	1480	Region 3	3.9	1.3	0.25	0.125	0.038
2-Nitrotoluene	88-72-2	0.31	Tapwater RSL	NC	None	0.31	0.10	0.25	0.125	0.071
3-Nitrotoluene	99-08-1	0.17	Tapwater RSL	750	Region 3	0.17	0.06	0.25	0.125	0.063
3,5-Dinitroaniline	618-87-1	NC	None	NC	None	NC	NC	0.25	0.125	0.07
4-Amino-2,6-Dinitrotoluene	19406-51-0	3.9	Tapwater RSL	NC	None	3.9	1.3	0.25	0.125	0.053
4-Nitrotoluene	99-99-0	4.2	Tapwater RSL	1900	Region 3	4.2	1.4	0.25	0.125	0.06
HMX	2691-41-0	100	Tapwater RSL	150	Region 3	100	30	0.25	0.125	0.043
Tetryl (Methyl-2,4,6-Trinitrophenylnitramine)	479-45-8	3.9	Tapwater RSL	NC	None	3.9	1.3	0.25	0.125	0.06
RDX	121-82-4	0.70	Tapwater RSL	360	Region 3	0.7	0.23	0.25	0.125	0.046
PETN	78-11-5	3.9	Tapwater RSL	85000	Region 3	3.9	1.3	4	2	0.58
Nitroglycerin	55-63-0	0.20	Tapwater RSL	138	Region 3	0.2	0.07	4	2	0.67
Perchlorate	14797-73-0	1.4	Tapwater RSL	9,300	Dean	1.4	0.47	0.4 ¹³	0.2 ¹³	0.1 ¹³
TARGET COMPOUND LIST PESTICIDES	(Katahdin will re	ference Low Leve	el Modificatio	n with extract	Final Volume = 2 mls	5.)				
4,4'-DDD	72-54-8		Tapwater RSL	0.01	Region 3	0.01	0.003	0.02	0.01	0.0018
4,4'-DDE	72-55-9	0.23	Tapwater RSL	105	NOAA	0.23	0.08	0.02	0.01	0.00098
4,4'-DDT	50-29-3	0.23	Tapwater RSL	0.001	MEDEP	0.001	0.0003	0.02	0.01	0.0018
ALDRIN	309-00-2	0.0046	Tapwater RSL	3	Region 3	0.0046	0.0015	0.01	0.005	0.0015
ALPHA-BHC	319-84-6	0.0071	Tapwater RSL	10	NOAA	0.0071	0.0024	0.01	0.005	0.0014

Chemical	CAS No.	Human Health PSL (µg/L)	Human Health PSL Reference	Ecological PSL (μg/L)	Ecological PSL Reference	Minimum PSL (µg/L)	PQLG (μg/L)	Katahdin LOQ (μg/L)	Katahdin LOD (μg/L g)	Katahdin DL (μg/L)
ALPHA-CHLORDANE	5103-71-9	0.22 ⁷	Tapwater RSL	0.0043	MEDEP	0.0043	0.0014	0.01	0.005	0.0015
BETA-BHC	319-85-7	0.025	Tapwater RSL	10	NOAA	0.025	0.008	0.01	0.005	0.0012
DELTA-BHC	319-86-8	NC	Tapwater RSL	141	Region 3	141	47	0.01	0.005	0.0025
DIELDRIN	60-57-1	0.0017	Tapwater RSL	0.056	MEDEP	0.0017	0.0006	0.02	0.01	0.0013
ENDOSULFAN I	959-98-8	10 ⁸	Tapwater RSL	0.056	MEDEP	0.056	0.019	0.01	0.005	0.0013
ENDOSULFAN II	33213-65-9	10 8	Tapwater RSL	0.056	MEDEP	0.056	0.019	0.02	0.01	0.0011
ENDOSULFAN SULFATE	1031-07-8	10 8	Tapwater RSL	2.22	NOAA	2.22	0.74	0.02	0.01	0.0013
ENDRIN	72-20-8	0.23	Tapwater RSL	0.036	MEDEP	0.036	0.012	0.02	0.01	0.0017
ENDRIN ALDEHYDE	7421-93-4	0.23 ⁹	Tapwater RSL	0.15	NOAA	0.15	0.05	0.02	0.01	0.0012
ENDRIN KETONE	53494-70-5	0.23 9	Tapwater RSL	NC	None	0.23	0.08	0.02	0.01	0.0016
GAMMA-BHC (LINDANE)	58-89-9	0.041	Tapwater RSL	0.01	Region 3	0.01	0.003	0.01	0.005	0.0014
GAMMA-CHLORDANE	5103-74-2	0.22 7	Tapwater RSL	0.0043	MEDEP	0.0043	0.0014	0.01	0.005	0.0012
HEPTACHLOR	76-44-8	0.002	Tapwater RSL	0.0038	MEDEP	0.002	0.0007	0.01	0.005	0.0016
HEPTACHLOR EPOXIDE	1024-57-3	0.0038	Tapwater RSL	0.0038	MEDEP	0.0038	0.0013	0.01	0.005	0.0015
METHOXYCHLOR	72-43-5	3.7	Tapwater RSL	0.03	MEDEP	0.03	0.01	0.1	0.05	0.0017
TOXAPHENE	8001-35-2	0.015	Tapwater RSL	0.0002	MEDEP	0.0002	0.00007	0.2	0.1	0.034
TARGET COMPOUND LIST PCBs	(Katahdin will re	ference Low Leve		n with extract	Final Volume = 2 mls	i.)				
AROCLOR-1016	12674-11-2	0.14	Tapwater RSL	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.03
AROCLOR-1221	11104-28-2	0.0046	Tapwater RSL	0.014	MEDEP 13	0.0046	0.0015	0.1	0.05	0.04
AROCLOR-1232	11141-16-5	0.0046	Tapwater RSL	0.014	MEDEP 13	0.0046	0.0015	0.1	0.05	0.018
AROCLOR-1242	53469-21-9	0.039	Tapwater RSL	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.036
AROCLOR-1248	12672-29-6	0.039	Tapwater RSL	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.04
AROCLOR-1254	11097-69-1	0.039	Tapwater RSL	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.016
AROCLOR-1260	11096-82-5	0.039	Tapwater RSL	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.034

Date: September 2014 Worksheet 15 Page 88 of 178

Chemical	CAS No.	Human Health PSL (µg/L)	Human Health PSL Reference	Ecological PSL (μg/L)	Ecological PSL Reference	Minimum PSL (μg/L)	PQLG (µg/L)	Katahdin LOQ (μg/L)	Katahdin LOD (μg/L g)	Katahdin DL (μg/L)
AROCLOR-1262	37324-23-5	NC	None	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.013
AROCLOR-1268	11100-14-4	NC	None	0.014	MEDEP 13	0.014	0.005	0.1	0.05	0.014
Petroleum Hydrocarbon Fraction (EPH/VPH)										
C5-C8 aliphatics		200	MEDEP	NC	None	200	70	100	75	50
C9-C12 Aliphatics		500	MEDEP	NC	None	500	200	100	75	50
C9-C18 Aliphatics		500	MEDEP	NC	None	500	200	100	75	50
C19-C36 Aliphatics		8,000	MEDEP	NC	None	8,000	3,000	100	75	50
C9-C10 Aromatics		200	MEDEP	NC	None	200	70	100	75	50
C11-C22 Aromatics		200	MEDEP	NC	None	200	70	100	75	50

Bolded rows indicate that either the human health or ecological PSL is between the laboratory LOQ and LOD. The Partnering Team has agreed to accept these data for decision making if results less than the LOQ are "J" qualified and if the results are discussed in the RI.

Shaded and bolded rows indicate that either the human health or ecological PSL is less than the LOD. In cases where the LOD is greater than the PSL and the contaminant was not detected, the contaminant will not be retained as a COPC. However, the uncertainty associated with this decision will be discussed in the risk assessment section. Moreover, a discussion regarding the likelihood of the presence of that contaminant (e.g., based on historical site uses) will be included in the risk assessment section.

** These metals will be analyzed by SW-846 6020.

* (SIM) Indicates that these compounds will be reported from a Selected Ion Monitoring (SIM) analysis.

Pesticide and PCB analyses will be concentrated to a 2 mL final volume to achieve lower detection limits.

CAS = Chemical Abstract Service.

PQLG = Project Quantitation Limit Goal.

NC = No criterion.

RSL = Regional Screening Levels

NOAA = National Oceanic and Atmospheric Administration

Note: At the time of data evaluation, the most recent screening criteria will be used for the HHRA and ERA.

Human Health PSL References

The USEPA RSL (May 2014) tap water RSL for non-carcinogens is adjusted by dividing by 10, equivalent to hazard quotients of 0.1. The tap water RSLs for carcinogens (not adjusted) is equivalent to and ILCRs of 1E-6. Remediation Guidelines for Petroleum Contamination Sites in Maine (MEDEP, 2014).

Footnotes

- 1 Hexavalent chromium analysis will be conducted by ALS. ALS LOQs, LODs, and DLs are provided.
- 2 The value presented is for vanadium and compounds.
- 3 The value presented is for 1,3-dichloropropene.
- 4 The value presented is for 4-nitroaniline.
- 5 The value presented is for acenaphthene.
- 6 The value presented is for pyrene.
- 7 The value presented is for chlordane.
- 8 The value presented is for endosulfan.
- 9 The value presented is for endrin.
- 10 Lower value than MEDEP value of 0.91 µg/L. MEDEP regulations note that statewide criteria mush not exceed federal water quality criteria.
- 11 Chronic value derived by division of acute value by 10.
- 12 Value for total PCBs.
- 13 Perchlorate analysis will be conducted by Microbac. Microback LOQs, LODs, and DLs are provided.

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date: September 2014 Worksheet 15 Page 89 of 178

Ecological PSL References

Sources Selected in the Following Order of Preference:

MEDEP – Maine DEP surface water quality criteria (MEDEP, 2012b)

NRWQC – USEPA National Recommended Water Quality Criteria, chronic freshwater values (USEPA, 2013)

Region 3 – USEPA Region 3 Freshwater Screening Benchmarks (USEPA, July 2006b)

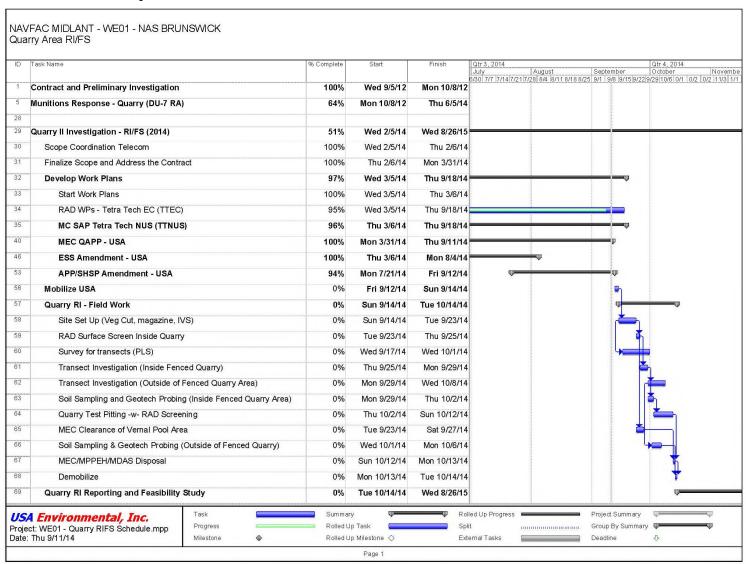
NOAA – NOAA Screening Quick Reference Tables for freshwater surface waters (Buchman, 2008)

Dean - KE, Palachek RM, Noel JM, et al. 2004. Development of freshwater water-quality criteria for perchlorate. Environ Toxicol Chem 23(6):1441-1451

CTO 69 031303/P

Worksheet 16 Page 90 of 178

SAP Worksheet #16 -- Project Schedule/Timeline Table



Revision: 1

Date: September 2014

Worksheet 17 Page 91 of 178

SAP Worksheet #17 -- Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

17.1 RATIONALE FOR SAMPLING APPROACH

The sampling strategy for the Quarry Area is based on a judgmental (biased) sampling design. Sample

locations were selected to evaluate areas that appeared to have previous munitions, quarrying, landfilling,

and land-farming activities as described in Worksheets #10 and #11 during which releases may have

occurred and to confirm the absence of related hazardous waste contaminants at concentrations of

concern associated with empty drums and/or landfilled construction debris discovered during the 2010

through 2012 MEC investigations.

The objective of the sampling is to determine if contamination related to historical use of the site is

present at levels of concern. Based on the results to date and the complex history of multiple site uses,

the subject site was divided into the following DUs (see Figure 11-1 and Worksheets #10 and #11 for

detailed descriptions of the site):

DU1, Quarried Backfill Area North of Radar Tower Access Road (soil)

DU2, Quarried Backfill Area Inside Quarry Fence (soil)

DU3, Landfarming Area (soil)

DU4a, Detonation Area (soil)

DU4b, Kickout Area (soil)

DU5, Seasonal Drainage Areas (sediment and surface water)

DU6, Groundwater (addressed in separate previous investigation)

Although the fence may or may not be removed in the future, the purpose of the fence construction was

to prevent access to the area of concern, encompassing the central area of the site (DU2, DU3, DU4a

and partially enclosing DU4b and DU5).

17.2 SAMPLING DESIGN

This section describes the sampling methods and locations, the numbers of samples to be collected, and

the sampling frequency. The general study boundaries for the DUs are identified in Worksheet #11 and

Figure 11-1 and will be refined based on the investigation findings. The overall site boundary will be

determined based on the extent of MEC/MPPEH findings during the concurrent MEC investigation

completion by USA. Contingent samples are included in reserve, in the event that an item is encountered

that is indicative of a point source environmental release. Otherwise, pre-determined sampling locations

Revision: 1 Date: September 2014

Worksheet 17
Page 92 of 178

within the study boundaries were selected to provide spatial coverage of known and suspected areas of potential releases. Table 17-1 details the sampling and analytical rationales. Figure 17-1 presents the 70 sample and/or lithology locations for each DU and also shows the MEC investigation planned extent, which corresponds to the maximum anticipated overall site boundary. Figure 17-2 provides an enlarged

in view of the area shown on Figure 17-1 and also shows the previous geophysics investigation results.

Sample locations will be subject to selection based in part on field conditions as described in Worksheet #14, with anomaly avoidance techniques by a UXO Technician for safety purposes. If a metallic anomaly is encountered less than 2 feet bgs, a first attempt by a USA UXO Technician will be conducted to remove the source of the anomaly; otherwise, sample locations will be moved slightly to a nearby location without anomalies. The field team will collect VOC and VPH data as soon as possible after MEC and radiological screening. Table 17-1 details the DU sampling and/or lithology locations, which are depicted on Figure 17-1, with an enlarged view on Figure 17-2. Figures 17-3A through 17-3D provide the sample collection decision trees for DU1 (Figure 17-3A), DU2 (Figure 17-3B), DU3 (Figure 17-3B), DU4a (Figure 17-3B), DU4b (Figure 17-3C), and DU5 (Figure 17-3D). Sampling methodology is described in Worksheet #14.

The pertinent DU details of the sampling design are discussed below. If chemical data are collected from a soil DU, risk assessments will be conducted and the outcome of these assessments will determine the path forward in accordance with Figure 17-3A through 17-3D.

DU1, Quarried Backfill Area North of Radar Tower Access Road - Surface and Subsurface Soil

Although not supported by MEC investigation results to date, surface and subsurface soil within DU1 may be contaminated based on the quarrying and backfilling activities that extended into this area, and it is also possible that munitions items are present in backfill materials. Landfarming did not take place in this area nor have drums been identified in this area to date. The media of interest for DU1 are surface soil (0 to 1 foot bgs) and subsurface soil (greater than 1 foot bgs). However, soil contamination is only of concern if waste materials or munitions items are identified within the backfill used in this area. Locations both inside and outside of the 1958 quarry boundary will be investigated to determine both the extent of the quarried area and whether waste material or munitions are present within the backfill. Also, the depth to bedrock will be determined in at least one select location in this area to refine the overall site geologic information. If and only if evidence of waste/munitions disposal is found within the backfill, full-suite analyses will be conducted (explosives including NG, TAL metals (10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP), VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, VPH). The vertical extent of the investigation within the quarried area will be to natural

Revision: 1 Date: September 2014 Worksheet 17 Page 93 of 178

material, and if there is evidence of waste disposal, samples will be collected both within and outside the quarried area at similar depths.

DU2, Quarried Backfill Area Inside Quarry Fence - Surface and Subsurface Soil

Based on evaluation of the chemical sampling that took place during the 2010 trenching effort, the quarried area of DU2 is expected to be more contaminated than DU1, although exceedances of riskbased criteria were not significant compared to the criteria and were sporadic in nature. Historical disposal practices within the quarried area were not documented; however, munitions items and construction debris have been encountered to date within the backfill, and a few empty drums have been observed on the ground surface. Although low-level concentrations of contaminants were encountered compared to screening criteria, the 2010 investigation was not extensive enough to be representative of site conditions. DU4b, Kickout Area, overlies all of DU2; however, concerns for DU4b are surficial and are primarily associated with the potential presence of MEC, and these concerns will be addressed as part of DU4b. In addition, the DU2 ground surface was cleared of munitions items during previous efforts. DU3, Landfarming Area, overlies only the eastern portion of DU2. Fuel-related contaminants are a concern in this landfarming area and will be addressed as DU3. The media of interest for DU2 are surface soil (0 to 1 foot bgs) and subsurface soil (greater than 1 foot bgs). Locations both inside and outside of the 1958 quarry boundary will be investigated to determine both the extent of the quarried area and if waste material or munitions are present within the backfill. Due to the varied history and unknown disposal practices within the quarried area, full-suite analyses are warranted (explosives including NG, TAL metals (10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP), VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, and VPH). The vertical extent of the investigation within the quarried area will be to natural material. Also, the depth to bedrock will be determined at select locations to refine site geologic information.

Additionally, trenches will be advanced within DU2 as part of the MEC subsurface investigation (see the MEC SAP, under separate cover). Locations of trenches are biased to previously identified, high-density, geophysical anomaly areas where metallic items, which may include munitions items, are suspected. Up to two samples from each of 11 trenches will be collected, and due to the unknown disposal practices within the quarried area, analyses will be dependent on findings within trench. If only munitions items are encountered in a given trench, only analysis for MC-related constituents are warranted (explosives including NG and TAL metals [10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP]), but if hazardous waste sources are present, full-suite analyses are warranted ([explosives including NG, TAL metals [10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP], VOCs, SVOCs (including low-level PAHs), PCBs, pesticides, EPH, and VPH]. If more than two

Revision: 1

Page 94 of 178

Date: September 2014 Worksheet 17

sample locations per trench are warranted, contingency samples will be collected. If only construction debris is responsible for all anomalies in a given trench, then only one sample will be collected from the approximate center of the trench, with full-suite analyses to confirm the absence of contamination. The vertical extent of the investigation will be to natural material. In the event that a trench is unable to be excavated to natural material (e.g., water table is encountered), a contingent replacement soil boring will be drilled nearby. The contingent replacement soil boring location for each trench is predetermined as identified on Table 17-1.

DU3, Landfarming - Surface and Subsurface Soil

Fuel-related constituents are the primary concern for the landfarming area, DU3. DU4b, Kickout Area, overlies all of DU3; however, concerns for DU4b are surficial and are primarily related to the potential presence of MEC, and these concerns will be addressed as part of DU4b. In addition, the DU3 ground surface was cleared of munitions items during previous efforts. The media of interest for DU3 are surface soil (0 to 1 foot bgs) and subsurface soil (1 to 3 feet bgs). Also, the depth to bedrock will be determined within DU3 to refine site geologic information. Due to the varied history within this area, full-suite analyses are warranted [explosives including NG, TAL metals (10% of the samples will also be analyzed for hexavalent chromium, pH and ORP), VOCs, SVOCs (including low-level PAHs), PCBs, pesticides, EPH, and VPH]. The vertical extent of the investigation will be to bedrock.

DU4a, Detonation Area - Surface and Subsurface Soil

The Detonation Area (DU4a) is expected to have a greater probability of significant contamination than the Kickout Area (DU4b). Both surface (0 to 1 foot bgs) and subsurface soil (1 to 3 feet bgs) are media of interest because detonations typically include burial of items prior to detonation as a control measure to tamp the kick-outs. The estimated location of the open detonation area is shown on Figure 17-1 and is near the southeastern Quarry Area fence corner. It is noted that additional detonation areas may be identified during the MEC portion of the investigation. Although MEC is the main concern in this area, elevated MC concentrations may be present in addition to other non-MC-related constituents due to the varied history of site activities. Therefore, full-suite analyses are warranted (explosives including NG, TAL metals (10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP), VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, and VPH). The vertical extent of the investigation will be to 3 feet bgs.

Revision: 1 Date: September 2014

Worksheet 17 Page 95 of 178

DU4b, Kickout Area - Surface and Subsurface Soil

The depth of concern in DU4b is shallow because kickout items from munitions detonations are expected to have landed on the ground surface or the top few inches of soil, and MEC would be the primary concern in this area. Based on MEC findings to date, munitions items were located on the ground surface or just below the ground surface as expected; therefore, surface soil (0 to 1 foot bgs) is the primary concern in this area. Only MC (explosives including NG and TAL metals [10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP]) are suspected in this area. The horizontal DU4b boundary is to be determined as part of the pending MEC investigation. Also, the depth to bedrock will be determined within DU4b to refine site geologic information.

Two drums were identified in the area east of the rock wall that may have resulted in surface soil contamination; therefore, full-suite analyses (explosives including NG, TAL metals [10% of the samples will also be analyzed for hexavalent chromium, pH, and ORP], VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, and VPH) are warranted for samples collected at the location of these drums. Because migration of contaminants to subsurface soil is possible if a release of drum contents occurred, both surface (0 to 1 foot bgs) and subsurface (1 to 3 feet bgs) soil are of interest. In addition, if field observations indicate staining or elevated PID readings in other samples in this DU, contingency samples may be collected.

DU5, Seasonal Drainage Areas – Sediment and Surface Water

The medium of interest for DU5 are sediment and surface water within the seasonal drainage areas that collect surface water runoff from the site and that are located at the base of the rock face, along the Quarry Area fence, and at the Significant Vernal Pond #42 south of Old Route 24 (Figure 17-2). It is expected that the substrate in these area is more similar to sediment than soil, but moisture content and lithology will be evaluated the field by the site geologist. There is limited information regarding the history of the drainage areas, but drainage swales within the Quarry Area seem to correlate spatially with past quarrying activities and specifically the 1958 borrow pit (see Figure 17-2 for outline of 1958 borrow pit). Contaminant concentrations in sediment and surface water are expected to be reflective of runoff from the site as a whole; therefore, full-suite analyses are warranted (explosives including NG, perchlorate for surface water only, and TAL metals [10% of the sediment samples will also be analyzed for hexavalent chromium, pH, and ORP and 10% of the surface water samples will also be analyzed for hexavalent chromium], VOCs [at all surface water sample locations and select sediment locations] as shown in Worksheet #18, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, and VPH). Surface water quality data including specific conductance, temperature, pH, turbidity, ORP, and dissolved oxygen will

Former NAS Brunswick Quarry Area

UFP-SAP for Soil/Sediment/Surface Water RI

Revision: 1

Date: September 2014 Worksheet 17

Page 96 of 178

also be collected at each surface water sample location. The vertical boundary for sediment is 1 foot bgs;

0 to 6 inches below the sediment surface is the sediment interval associated with ecological exposure,

and results from 6 inches to 1 foot will provide information on sediment thickness and depth of potential

contamination. One surface water sample will be collocated at each of the three seasonal drainage

areas. Surface water samples will be collocated with sediment samples and will be collected from just

below the water surface, prior to draining of the associated surface water body.

DU6, Groundwater

The groundwater investigation was previously completed, and results are documented in the Technical

Memorandum Groundwater Report provided in Appendix H (Tetra Tech, 2014), and fracture trace

analysis and groundwater sampling were documented in the Bedrock Fracture Trace Analysis Report

(Tetra Tech, 2012b) provided in Appendix F.

17.3 FIELD QUALITY CONTROL SAMPLES

Field QC samples collected as part of the investigation will include field duplicates, trip blanks, and

equipment rinsate blanks for non-dedicated sampling equipment. Worksheet #20 presents the field QC

sample summary. Additional sample volume will be collected as necessary for laboratory QC matrix

spike (MS)/matrix spike duplicate (MSD) analyses as shown in this worksheet.

Date: September 2014 Worksheet 18 Page 97 of 178

SAP Worksheet #18 -- Sampling Locations and Methods/SOP Requirements Table (UFP-QAPP Manual Section 3.1.1)

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴	
DU1 Quarried	Backfill Area No	orth of Radar	Tower Access Road					
	QRY-SB01	1	QRY-SB01-0001 QRY-SB01- XXXX*	0-1 X-X	Up to 2			
	QRY-SB02	2	QRY-SB02-0001 QRY-SB02- XXXX*	0-1 X-X	Up to 2	Explosives and NG		
Soil	QRY-SB03	3	QRY-SB03-0001 QRY-SB03- XXXX*	0-1 X-X	Up to 2	TAL Metals ⁷ VOCs SVOCs EPH/VPH	SA-1.3 SA-2.5	
	QRY-SB04	4	QRY-SB04-0001 QRY-SB04- XXXX*	0-1 X-X	Up to 2	Pesticides PCBs		
	QRY-SB05	5	QRY-SB05-0001 QRY-SB05- XXXX*	0-1 X-X	Up to 2			

CTO 69 031303/P

Revision: 1 Date: September 2014 Worksheet 18 Page 98 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
DU2/DU3/DU4	a, DUs Inside Qu	arry Fence					
	QRY-SB07	7	QRY-SB07-0001	0-1	1		
	QRY-SB08 8		QRY-SB08- XXXX*	CONTINGENT REPLACMENT ³ Install with DPT rig			
	QIVI ODOO	8	QRY-SB08- XXXX*	only if excavation at Trench #12 not successful	Up to 2		
			QRY-SB09-	CONTINGENT REPLACEMENT ³			
	QRY-SB09	9	XXXX* QRY-SB09- XXXX*	Install with DPT rig only if excavation at Trench #16 not successful	Up to 2	Explosives and NG	
Soil	QRY-SB10	10	QRY-SB10- XXXX* QRY-SB10- XXXX*	CONTINGENT REPLACEMENT ³ Install with DPT rig only if excavation at Trench #15 not successful	Up to 2	TAL Metals ⁷ VOCs SVOCs EPH/VPH Pesticides PCBs	SA-1.3 SA-2.5
	QRY-SB12	12	QRY-SB12- XXXX* QRY-SB12- XXXX*	CONTINGENT REPLACEMENT 3 Install with DPT rig only if excavation at Trench #18 not successful	Up to 2		
	QRY-SB14	14	QRY-SB14- XXXX* QRY-SB14- XXXX*	CONTINGENT REPLACEMENT ³ Install with DPT rig only if excavation at Trench #24 not successful	Up to 2		

Revision: 1 Date: September 2014 Worksheet 18 Page 99 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
DU2/DU3/DU4a,	DUs Inside Qua	rry Fence (co	ntinued)				
	QRY-SB17	17	QRY-SB17- XXXX* QRY-SB17- XXXX*	CONTINGENT REPLACEMENT 3 Install with DPT rig only if excavation at Trench #13 not successful	Up to 2		
	QRY-SB18	18	QRY-SB18- XXXX* QRY-SB18- XXXX*	CONTINGENT REPLACEMENT 3 Install with DPT rig only if excavation at Trench #17 not successful	Up to 2	Explosives and NG	
Soil	QRY-SB19	19	QRY-SB19- XXXX* QRY-SB19- XXXX*	CONTINGENT REPLACEMENT 3 Install with DPT rig only if excavation at Trench #19 not successful	Up to 2	TAL Metals ⁷ VOCs SVOCs EPH/VPH Pesticides	SA-1.3 SA-2.5
	QRY-SB21	21	QRY-SB21-0001 QRY-SB21-0103 QRY-SB21- XXXX	0-1 1-3 X-X	3	PCBs	
	QRY-SB22	22	QRY-SB22- XXXX* QRY-SB22- XXXX*	CONTINGENT REPLACEMENT Install with DPT rig only if excavation at Trench #30 not successful	Up to 2		
	QRY-SB23	23	QRY-SB23-0001	0-1	1		
	QRY-SB25	25	QRY-SB25-0001 0-1		1		

Revision: 1 Date: September 2014 Worksheet 18 Page 100 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
DU2/DU3/DU4	a, DUs Inside Qu	arry Fence (c	ontinued)				
	QRY-SB27	27	QRY-SB27-0001 QRY-SB27-0103 QRY-SB27- XXXX	0-1 1-3 X-X	3		
	QRY-SB28	28	QRY-SB28- XXXX* QRY-SB28- XXXX*	CONTINGENT REPLACEMENT ³ Install with DPT rig only if excavation at Trench #26 not successful	Up to 2		
Soil	QRY-SB29	29	QRY-SB29- XXXX* QRY-SB29- XXXX*	CONTINGENT REPLACEMENT ³ Install with DPT rig only if excavation at Trench #31 not successful	Up to 2	Explosives and NG TAL Metals ⁷ VOCs SVOCs EPH/VPH Pesticides	SA-1.3 SA-2.5
	QRY-SB37	37	QRY-SB37-0001 QRY-SB37-0103 QRY-SB37- XXXX	0-1 1-3 X-X	3	PCBs	
	QRY-SB38	38	QRY-SB38-0001 QRY-SB38-0103 QRY-SB38- XXXX	0-1 1-3 X-X	3		
	QRY-SB40	40	QRY-SB40-0001 QRY-SB40-0103 QRY-SB40- XXXX	0-1 1-3 X-X	3		

Revision: 1 Date: September 2014 Worksheet 18 Page 101 of 178

Matrix	Sampling Location	Location Number	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
12/DU3/DU4	a, DUs Inside Qι	arry Fence (c	ontinued)				
	QRY-SB41	41	QRY-SB41- XXXX* QRY-SB41- XXXX*	CONTINGENT REPLACEMENT ³ Install with DPT rig only if excavation at Trench #29 not successful	Up to 2	Explosives and NG	
	QRY-SB43	43	QRY-SB43-0001 QRY-SB43-0103	0-1 1-3	2	TAL Metals ⁷ VOCs SVOCs EPH/VPH	SA-1.3 SA-2.5
	QRY-SB44	44	QRY-SB44-0001 QRY-SB44-0103	0-1 1-3	2	Pesticides PCBs	
Soil	QRY-SB50	50	QRY-SB50-0001 QRY-SB50-0103	0-1 1-3	2		
5 5	T12	Trench 12	QRY-T12-01 QRY-T12-02*	X-X X-X	Up to 2		
	T13	Trench 13	QRY-T13-01 QRY-T13-02*	X-X X-X	Up to 2	Explosives and NG	
	T14	Trench 14	QRY-T14-01 QRY-T14-02*	X-X X-X	Up to 2	TAL Metals ⁷	
	T15	Trench 15	QRY-T15-01 QRY-T15-02*	X-X X-X	Up to 2	If sample related to non- munitions issues (e.g.,	SA-1.3
	T16	Trench 16	QRY-T16-01 QRY-T16-02*	X-X X-X	Up to 2	drum, staining), add: VOCs	SA-1.3
	T17	Trench 17	QRY-T17-01 QRY-T17-02*	X-X X-X	Up to 2	SVOCs EPH/VPH Pesticides	
	T18	Trench 18	QRY-T18-01 QRY-T18-02*	X-X X-X	Up to 2		
	T19	Trench 19	QRY-T19-01 QRY-T19-02*	X-X X-X	Up to 2		

Date: September 2014 Worksheet 18 Page 102 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
DU2/DU3/DU4	a, DUs Inside Qu	uarry Fence (co	ontinued)				
	T20	Trench 20	QRY-T20-01 QRY-T20-02*	X-X X-X	Up to 2		
	T21	Trench 21	QRY-T21-01 QRY-T21-02*	X-X X-X	Up to 2		
	T22	Trench 22	QRY-T22-01 QRY-T22-02*	X-X X-X	Up to 2		
	T23	Trench 23	QRY-T23-01 QRY-T23-02*	X-X X-X	Up to 2		
	T24	Trench 24	QRY-T24-01 QRY-T24-02*	X-X X-X	Up to 2	Explosives and NG	
	T25	Trench 25	QRY-T25-01 QRY-T25-02*	X-X X-X	Up to 2	TAL Metals ⁷	
	T26	Trench 26	QRY-T26-01 QRY-T26-02*	X-X X-X	Up to 2	If sample related to non- munitions issues (e.g.,	
Soil	T27	Trench 27	QRY-T27-01 QRY-T27-02*	X-X X-X	Up to 2	drum, staining), add: VOCs	SA-1.3
	T28	Trench 28	QRY-T28-01 QRY-T28-02*	X-X X-X	Up to 2	SVOCs EPH/VPH Pesticides	
	T29	Trench 29	QRY-T29-01 QRY-T29-02*	X-X X-X	Up to 2	PCBs	
	T30	Trench 30	QRY-T30-01 QRY-T30-02*	X-X X-X	Up to 2		
	T31	Trench 31	QRY-T31-01 QRY-T31-02*	X-X X-X	Up to 2		
	T32	Trench 32	QRY-T32-01 QRY-T32-02*	X-X X-X	Up to 2		
	T33	Trench 33	QRY-T33-01 QRY-T33-02*	X-X X-X	Up to 2		

Revision: 1 Date: September 2014 Worksheet 18 Page 103 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴	
U4b, Kickou	t Area (East of Q	uarry Fence, r	orth of Old Route 2	4)				
	QRY-SB53	53	QRY-SB53-0001	0-1	1	Explosives and NG		
	QRY-SB54	54	QRY-SB54-0001	0-1	1	TAL Metals ⁷		
	QRY-SB55	55	QRY-SB55-0001	0-1	1			
	QRY-SB56	56	QRY-SB56-0001 QRY-SB56-0103	0-1 1-3	2	Explosives and NG TAL Metals VOCs SVOCs	SA-1.3	
Soil	QRY-SB57	57	QRY-SB57-0001 QRY-SB57-0103	0-1 1-3	2	EPH/VPH Pesticides PCBs		
	QRY-SB58	58	QRY-SB58-0001	0-1	1			
	QRY-SB59	59	QRY-SB59-0001	0-1	1			
	QRY-SB60	60	QRY-SB60-0001	0-1	1			
	QRY-SB61	61	QRY-SB61-0001	0-1	1	Explosives and NG TAL Metals ⁷		
	QRY-SB62	62	QRY-SB62-0001	0-1	1	TAL METAIS		
	QRY-SB63	63	QRY-SB63-0001	0-1	1			
	QRY-SB64	64	QRY-SB64-0001	0-1	1			
	QRY-SB65	65	QRY-SB65-0001	0-1	1			
U4b, Kickou	t Area (South of	Quarry Fence	south of Old Route	24)				
	QRY-SB66	66	QRY-SB66-0001	0-1	1	Explosives and NG		
	QRY-SB67	67	QRY-SB67-0001	0-1	1			
Soil	QRY-SB68	68	QRY-SB68-0001	0-1	1	TAL Metals ⁷	SA-1.3	
	QRY-SB69	69	QRY-SB69-0001	0-1	1			

031303/P

0-1

1

QRY-SB70

70

QRY-SB70-0001

Revision: 1 Date: September 2014 Worksheet 18 Page 104 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
Contingency ⁵					•		
Soil	QRY-SB##- XXXX	Not Applicable	Same ID designation as associated area with sequential Sample ID Number	TBD in field	Up to 12	Explosives and NG TAL Metals ⁷ If contingency sample related to non-munitions issues (e.g., drum, staining), add: VOCs SVOCs EPH/VPH Pesticides PCBs	SA-1.3 SA-2.5
DU5, Seasonal	l Drainage Areas	5					
Sediment	QRY-SD01	1	QRY-SD01-000.5 QRY-SD01-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ SVOCs EPH/VPH Pesticides PCBs No VOCs	SA-1.2
	QRY-SD02	2	QRY-SD02-000.5 QRY-SD02-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ SVOCs EPH/VPH Pesticides PCBs No VOCs	
	QRY-SD03	3	QRY-SD03-000.5 QRY-SD03-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ VOCs SVOCs EPH/VPH Pesticides PCBs	

Date: September 2014 Worksheet 18 Page 105 of 178

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
Sediment	QRY-SD04	4	QRY-SD04-000.5 QRY-SD04-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ SVOCs EPH/VPH Pesticides PCBs No VOCs	SA-1.2
	QRY-SD05	5	QRY-SD05-000.5 QRY-SD05-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ VOCs SVOCs EPH/VPH Pesticides PCBs	
	QRY-SD06	6	QRY-SD06-000.5 QRY-SD06-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ SVOCs EPH/VPH Pesticides PCBs No VOCs	
	QRY-SD07	7	QRY-SD07-000.5 QRY-SD07-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ VOCs SVOCs EPH/VPH Pesticides PCBs	
	QRY-SD08	8	QRY-SD08-000.5 QRY-SD08-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ SVOCs EPH/VPH Pesticides PCBs No VOCs	

Revision: 1 Date: September 2014

Worksheet 18 Page 106 of 178

CTO 69

Matrix ¹	Sampling Location	Location Number ²	Sample ID Number	Target Sample Depth	Number of Samples	Analytical Group	Sampling SOP Reference ⁴
Sediment	QRY-SD09	9	QRY-SD09-000.5 QRY-SD09-0.501	0-0.5 0.5-1	2	Explosives and NG TAL Metals ⁷ SVOCs EPH/VPH Pesticides PCBs No VOCs	SA-1.2
	QRY-SW03	4	QRY-SW03- XXXX ⁶	NA	1	Explosives, NG, and perchlorate	
Surface	QRY-SW05	5	QRY-SW05- XXXX ⁶	NA	1	TAL Metals ⁷ SVOCs	SA-1.2
Water	QRY-SW08	8	QRY-SW08- XXXX ⁶	NA	1	EPH/VPH Pesticides PCBs VOCs	SA-1.1

- * = XXXX represents the depth interval of the sample in feet, depth to be determined in the field.
- 1. Sampling approach proposed relies on focusing data collection activities in several areas with various site conceptual model differences. Lateral and vertical boundaries for DU1 through DU5 are not yet established. While some DUs overlap laterally, vertically these overlapping DUs can be differentiated based on the current-day conceptual site model. Specifically, DU3 Landfarming Area and DU4b Kickout Area are vertically situated above DU2 Quarried Backfill Area Inside Quarry Fence:
 - DU1 Quarried Backfill Area north of Radar Tower Access Road
 - DU2 Quarried Backfill Area Inside Quarry Fence
 - DU3 Landfarming Area
 - DU4a Detonation Area
 - DU4b Kickout Area
 - **DU5 Seasonal Drainage Areas**
 - DU6 Groundwater (addressed in separate previous investigation)
- 2. Gap in soil numbering system is locations where lithology only borings, no sample collection and laboratory analysis proposed at these locations. Also, gap in sediment numbering system because there are fewer surface water samples than sediment samples and surface water sample numbers match those of collocated sediment samples.
- 3. Contingent Replacement samples not included in analytical totals because these locations will only be sampled if MEC RI Trench samples cannot be collected, the Contingent Replacement samples would be collected in place of the MEC RI Trench samples. If collected, Contingent Replacement sample analysis would be the same as MEC RI Trench sample analysis.
- 4. SOPs located in Appendix G.
- 5. Contingency samples will be collected only if warranted (e.g., staining, elevated PID readings, munitions items, drums).
- Last four digits for surface water indicate the date (month and year) the sample is collected.
- 7. Ten percent of the soil and sediment samples collected for TAL metals analysis will also be analyzed for hexavalent chromium, pH, and ORP. Ten percent of the surface water samples will be analyzed for hexavalent chromium (pH and ORP will be measured in the field).

Date: September 2014 Worksheet 19 Page 107 of 178

SAP Worksheet #19 -- Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

MATRIX	ANALYTICAL GROUP	ANALYTICAL AND PREPARATION METHOD/SOP REFERENCE	CONTAINERS (number, size, and type)	SAMPLE VOLUME (units)	PRESERVATION REQUIREMENTS (chemical, temperature, light protected)	MAXIMUM HOLDING TIME (preparation/ analysis)
	TCL VOCs	SW-846 5030, 8260B/ CA-202	Three 40- milliliter (mL)volatile vials	40 mL	Hydrochloric acid (HCl) to pH< 2, cool to ≤ 6 °C	14 days to analysis
	TAL Metals (total)	SW-846 3010B, and 6020A, 7470A/CA-604, CA-615, CA-627	One 1-liter (L) high density-polyethylene (HDPE) bottle	100 mL	Nitric acid (HNO3) to pH < 2; cool to ≤6 °C	6 months to analysis except mercury, which is 28 days to analysis
	TCL SVOCs (including low- level PAHs and 1,4- dioxane) SW-846 3510C or 3520C 8270D/8270D SIM/ CA- 226, CA-213, CA-502		Two 1-L amber glass bottles	1,000 mL	Cool to 0 to 6 °C	7 days for preparation; 40 days to analysis
	Explosives plus NG	SW-846 8330B Katahdin CA-402, CA-548	Two 1-L glass amber bottles	1L	Cool to 0 to 6 °C	7 days until extraction, 40 days to analysis
Surface Water and Aqueous QC	TCL Pesticides and PCBs	SW-846 3510C/8081B/8082A, Katahdin SOP-302, CA-329, CA-515	Two 1-L glass amber bottles	1,000 mL	Cool to 0 to 6 °C	7 days (pesticides) 30 days (PCBs) until extraction; 40 days to analysis
	VPH	MADEP-VPH-04-1.1 Katahdin SOP CA-312	Two 40-mL glass vials	15 g	15 mL methanol, cool to ≤ 6 °C	28 days to analysis
	EPH	MADEP-EPH-04-1.1 Katahdin SOP CA-322, CA-511	Two 1-L amber glass bottles	1,000 mL	5 mL of 1:1 HCl, cool to ≤ 6 °C	14 days to extraction, 40 days to analysis
	Hexavalent Chromium	SW-846 7199 / ALS SOP GEN-7199	250mL high-density polyethylene (HDPE)	10 mL	cool to 0 - 6° C	24 hours
	Perchlorate	SW-846 6850, HPLC06	One 250mL HDPE	40 mL	Cool to ≤ 6 °C	28 days to analysis

Date: September 2014 Worksheet 19 Page 108 of 178

MATRIX	ANALYTICAL GROUP	ANALYTICAL AND PREPARATION METHOD/SOP REFERENCE	CONTAINERS (number, size, and type)	SAMPLE VOLUME (units)	PRESERVATION REQUIREMENTS (chemical, temperature, light protected)	MAXIMUM HOLDING TIME (preparation/ analysis)
	TCL VOCs	SW-846 5035, 8260B /CA-202, CA-214	Three Terra Core samplers	5 grams (g)	Placed in water and frozen to -10 ° C; or sodium bisulfate solution	48 hours from sampling to freezing; 14 days to analysis to for frozen or bisulfate preserved samples
	TAL Metals	SW-846 3050B, and 6020A, 7471B/CA-605, CA-611, CA-627	One 4-ounce (oz) glass jar with a Teflon-lined lid	2 g	Cool to 0 to 6 °C	6 months to analysis for inductively coupled plasma (ICP) metals; 28 days for mercury
	TCL Pesticides/ PCBs	SW-846 3540 /8081B/ 8082A, Katahdin SOP-302,CA- 329, CA-524	One 4-oz glass jar with a Teflon-lined lid	15 g	Cool to 0 to 6 °C	14 days (pesticides) 30 days (PCBs) until extraction; 40 days to analysis
Solid	TCL SVOCs (including low- level PAHs and 1,4- dioxane)	SW-846 3540C or 3550C, 8270D/8270D SIM/ CA- 226, CA-213, CA-512, CA-526	One 4-oz glass jar with a Teflon-lined lid	30 g	Cool to 0 to 6 °C	14 days to extraction; 40 days to analysis
	Explosives plus NG	SW-846 8330B Katahdin CA-402, CA-548	One 4-oz glass jar	30 g	Cool to 0 to 6 °C	14 days until extraction; 40 days to analysis
	VPH	MADEP-VPH-04-1.1 Katahdin SOP CA-312	Two 40-mL glass vials	15 g	15 mL methanol Cool to 0 to 6 °C	28 days to analysis
	EPH	MADEP-EPH-04-1.1 Katahdin SOP CA-322, CA-511	4-oz wide-mouth jar	10 g	Cool to 0 to 6 °C	14 days to extraction; 40 days to analysis

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

Date: September 2014 Worksheet 19 Page 109 of 178

MATRIX	ANALYTICAL GROUP	ANALYTICAL AND PREPARATION METHOD/SOP REFERENCE	CONTAINERS (number, size, and type)	SAMPLE VOLUME (units)	PRESERVATION REQUIREMENTS (chemical, temperature, light protected)	MAXIMUM HOLDING TIME (preparation/ analysis)
	Hexavalent Chromium	SW-846 7199 / ALS SOP GEN-7199, ALS SOPGEN-3060A	1-4 oz wide mouth	2.5 g	Cool to 0 to 6 °C	30 days until digestion; 7 days until pH adjustment and analysis
	ORP reported as Eh	ASTM D1498 / ALS SOP GEN-REDOX	1-4 oz glass jar no headspace	20 g	Cool to 0 to 6 °C, no headspace	ASAP
	рН	SW-4-846 9045C / ALS SOP GEN-9045C	1-4-oz glass jar	20 g	Cool to 0 to 6 °C	ASAP
	TCLP regulatory list organics	SW-846 1311, SW-846 5030/8260B, SW-846 8151A, SW-846 3510C 8081A, SW-846 3510C/8270D	One 4-oz glass jar	25 g VOCs/ 100 g SVOCs	Cool to 0 to 6 °C	14 days to TCLP extraction; 14 days to analysis for VOC and 7 days until extraction; 40 days to analysis for all SVOCs
Aqueous and Solid IDW ⁽¹⁾	TCLP regulatory list inorganics	SW-846 1311, SW-846 3010A/6010C, SW-846 7470A	One 4-oz glass jar	100 g	Cool to 0 to 6 °C	180 days to TCLP extraction, except mercury, which is 28 days. Then 180 days to analysis, except mercury, which is 28 days to analysis
		SW-846 1010A	One 4-oz glass jar	Unspecified	Cool to ≤ 6 °C	7 days to analysis
	Ignitability	Unspecified	One 500 mL plastic bottle	Unspecified	Cool to ≤ 6 °C	7 days to analysis
	рН	SW-846 9045D	One 4-oz glass jar with a Teflon-lined lid	20 g	Cool to < 6 °C	Analyze as soon as possible

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

Date: September 2014 Worksheet 19 Page 110 of 178

MATRIX	ANALYTICAL GROUP	ANALYTICAL AND PREPARATION METHOD/SOP REFERENCE	CONTAINERS (number, size, and type)	SAMPLE VOLUME (units)	PRESERVATION REQUIREMENTS (chemical, temperature, light protected)	MAXIMUM HOLDING TIME (preparation/ analysis)
		SW-846 9040C	One 500-mL plastic bottle	50 mL	Cool to ≤6 °C	Analyze as soon as possible
	Reactive		One 4-oz glass jar	5 g	Cool to 0 to 6 °C	14 days to analysis
	cyanide	SW-846 9012A	One 250-mL plastic bottle	50 mL	Sodium hydroxide to a pH > 12; Cool to ≤6 °C	14 days to analysis
	Reactive sulfide	SW-846 9030, 9034	One 4-oz glass jar	25 g	Cool to 0 to 6 °C	7 days to analysis
		SM4500S-2 CF	One 250-mL plastic bottle	250 mL	Zinc acetate and sodium hydroxide; Cool to ≤ 6°C	7 days to analysis

¹ IDW sample analyses are presented on this worksheet for field personnel use only. QC samples are not required for IDW samples. No QC information will be presented for these analyses in the remaining worksheets.

Revision: 1 Date: September 2014 Worksheet 20 Page 111 of 178

SAP Worksheet #20 -- Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	No. of Samples	No. of Field Duplicates ⁽¹⁾	No. of MS/MSDs ⁽²⁾	No. of Equip. Blanks ⁽³⁾	No. of VOC Trip Blanks ⁽⁴⁾	Total No. of Samples to Lab (excluding MS/MSDs)
	Explosives including NG	Up to 10	1	1/1	0	0	11
	TAL Metals	Up to 10	1	1/1	0	0	11
	TCL VOCs	Up to 10	1	1/1	0	1	12
DU1 Surface and Subsurface Soil North of the Quarry	TCL SVOCs (including low-level PAHs)	Up to 10	1	1/1	0	0	11
Fence (north of road to radar tower)	TCL Pesticides and PCBs	Up to 10	1	1/1	0	0	11
towery	EPH/VPH	Up to 10	1	1/1	0	0	11
	Hexavalent chromium	Up to 1	1	1/1	0	0	2
	рН	Up to 1	1	0	0	0	2
	ORP	Up to 1	1	0	0	0	2
DUO DUO	Explosives including NG	24	2	2/2	2	0	28
DU2, DU3, DU4a, and DU4b	TAL Metals	24	2	2/2	2	0	28
Surface and Subsurface Soil Inside Quarry Fence	TCL VOCs	24	2	2/2	2	3	29
	TCL SVOCs (including low-level PAHs)	24	2	2/2	2	0	28

Date: September 2014 Worksheet 20 Page 112 of 178

Matrix	Analytical Group	No. of Samples	No. of Field Duplicates ⁽¹⁾	No. of MS/MSDs ⁽²⁾	No. of Equip. Blanks ⁽³⁾	No. of VOC Trip Blanks ⁽⁴⁾	Total No. of Samples to Lab (excluding MS/MSDs)
	TCL Pesticides and PCBs	24	2	2/2	2	0	28
	EPH/VPH	24	2	2/2	2	0	28
	Hexavalent chromium	2	1	1/1	1	0	4
	рН	2	1	0	0	0	3
	ORP	2	1	0	0	0	3
	Explosives including NG	22 to 44	3	3/3	2	0	49
	TAL Metals	22 to 44	3	3/3	2	0	49
	TCL VOCs	22 to 44	3	3/3	2	5	54
DU2, DU3, and DU4b Surface and Subsurface	TCL SVOCs (including low-level PAHs)	22 to 44	3	3/3	2	0	49
Soil Inside Quarry Fence (Trenches)	TCL Pesticides and PCBs	22 to 44	3	3/3	2	0	49
	EPH/VPH	22 to 44	3	3/3	2	0	49
	Hexavalent chromium	2 to 4	1	1/1	1	0	6
	рН	2 to 4	1	0	0	0	5

Date: September 2014 Worksheet 20 Page 113 of 178

Matrix	Analytical Group	No. of Samples	No. of Field Duplicates ⁽¹⁾	No. of MS/MSDs ⁽²⁾	No. of Equip. Blanks ⁽³⁾	No. of VOC Trip Blanks ⁽⁴⁾	Total No. of Samples to Lab (excluding MS/MSDs)
	ORP	2 to 4	1	0	0	0	5
	Explosives including NG	15	1	1/1	1	0	17
	TAL Metals	15	1	1/1	1	0	17
	TCL VOCs	4	1	1/1	1	1	7
DU4b East of	TCL SVOCs (including low-level PAHs)	4	1	1/1	1	0	6
Quarry Fence (north of Old Route 24)	TCL Pesticides and PCBs	4	1	1/1	1	0	6
	EPH/VPH	4	1	1/1	1	0	6
	Hexavalent chromium	2	1	1/1	1	0	4
	рН	2	1	0	0	0	3
	ORP	2	1	0	0	0	3
DU4b South of Quarry Fence	Explosives including NG	5	0	0	1	0	6
(south of Old Route 24)	TAL Metals	5	0	0	1	0	6

Date: September 2014 Worksheet 20 Page 114 of 178

Matrix	Analytical Group	No. of Samples	No. of Field Duplicates ⁽¹⁾	No. of MS/MSDs ⁽²⁾	No. of Equip. Blanks ⁽³⁾	No. of VOC Trip Blanks ⁽⁴⁾	Total No. of Samples to Lab (excluding MS/MSDs)
	TCL VOCs	0	0	0	0	0	0
	TCL SVOCs (including low-level PAHs)	0	0	0	0	0	0
	TCL Pesticides and PCBs	0	0	0	0	0	0
	EPH/VPH	0	0	0	0	0	0
	Hexavalent chromium	1	1	1/1	1	0	3
	рН	1	1	0	0	0	2
	ORP	1	1	0	0	0	2
	Explosives including NG	Up to 12	0	0	0	0	12
	TAL Metals	Up to 12	0	0	0	0	12
Contingency Samples	TCL VOCs	Up to 12	0	0	0	0	12
	TCL SVOCs (including low-level PAHs)	Up to 12	0	0	0	0	12
	TCL Pesticides and PCBs	Up to 12	0	0	0	0	12

Date: September 2014 Worksheet 20 Page 115 of 178

Matrix	Analytical Group	No. of Samples	No. of Field Duplicates ⁽¹⁾	No. of MS/MSDs ⁽²⁾	No. of Equip. Blanks ⁽³⁾	No. of VOC Trip Blanks ⁽⁴⁾	Total No. of Samples to Lab (excluding MS/MSDs)
	EPH/VPH	Up to 12	0	0	0	0	12
	Hexavalent chromium	Up to 1	0	0	0	0	1
	рН	Up to 1	0	0	0	0	1
	ORP	Up to 1	0	0	0	0	1
	Explosives	18	1	1/1	1	0	20
	TAL Metals	18	1	1/1	1	0	20
	TCL VOCs	6	1	1/1	1	1	9
	TCL SVOCs	18	1	1/1	1	0	20
DU5 Sediment	TCL Pesticides and PCBs	18	1	1/1	1	0	20
	EPH/VPH	18	1	1/1	1	0	20
	Hexavalent chromium	2	1	1/1	1	0	4
	рН	2	1	0	0	0	3
	ORP	2	1	0	0	0	3

Date: September 2014 Worksheet 20 Page 116 of 178

Matrix	Analytical Group	No. of Samples	No. of Field Duplicates ⁽¹⁾	No. of MS/MSDs ⁽²⁾	No. of Equip. Blanks ⁽³⁾	No. of VOC Trip Blanks ⁽⁴⁾	Total No. of Samples to Lab (excluding MS/MSDs)
	Explosives	3	1	1/1	1	0	5
	TAL Metals	3	1	1/1	1	0	5
	TCL VOCs	3	1	1/1	1	1	6
DU5	TCL SVOCs	3	1	1/1	1	0	5
Surface Water	TCL Pesticides and PCBs	3	1	1/1	1	0	5
	EPH/VPH	3	1	1/1	1	0	5
	Perchlorate	3	1	1/1	1	0	5
	Hexavalent chromium	1	1	1/1	1	0	3

- 1 Duplicates will be collected at a rate of 1 per 20 total discrete samples.
- MS/MSD samples will be collected at a rate of 1 per 20 discrete samples. Although MS/MSDs are not typically considered field QC samples, they are included here because location determination is often established in the field. The MS/MSDs are not included in the total number of samples sent to the laboratory.
- 3 Equipment blanks will be collected at a frequency of 1 per 20 field samples per type of equipment per medium (soil [surface and subsurface soil] one per 20 from the hand auger, one per 20 from the DPT rig, and one per 20 from the excavator bucket; sediment one from the hand auger; surface water one from dip cup/weighted bottle). Equipment blanks will be analyzed for the same analytical group as samples collected from the associated samples.

4 Trip blanks will be collected at a frequency of one per cooler containing VOC samples.

Date: September 2014 Worksheet 21 Page 117 of 178

SAP Worksheet #21 -- Project Sampling SOP References Table (UFP-QAPP Manual Section 3.1.2)

Reference Number	Title, Revision Date, and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SA-2.5	SA-2.5 – Direct-Push Technology	Tetra Tech NUS	DPT rig (provided by drilling subcontractor)	N	
SA-1.3	SA-1.3 - Soil Sampling	Tetra Tech NUS	Stainless steel or disposable trowel, long-handled sampling device (hand auger)	Y	
GH-1.5	GH-1.5 - Borehole and Sample Logging	Tetra Tech NUS	None	N	
SA-7.1	SA-7.1 - Decontamination of Field Equipment	Tetra Tech NUS	None	N	
SA-1.2	SA-1.2 - Surface Water and Sediment Sampling	Tetra Tech NUS	Stainless steel or disposable trowel, long-handled sampling device (hand auger)	Y	
SA-1.1	Groundwater Sample Acquisition and Onsite Water Quality Testing	Tetra Tech NUS	Water Quality Meter	Y	
GH-1.3	GH-1.3 - Soil and Rock Drilling Methods	Tetra Tech NUS	DPT rig (provided by drilling subcontractor)	Y	
SA-6.1	SA-6.1 - Non-Radiological Sample Handling	Tetra Tech NUS	Field logbook, sample log sheets, boring logs, chain of custody forms	N	
MRP SOP 05	GPS Data Collection and Transfer	Tetra Tech NUS	Trimble GPS unit – hand held	N	
SA-6.3	SA-6.3 - Field Documentation	Tetra Tech NUS	Field logbook, sample log sheets, boring logs, trench logs, chain-of- custody forms	N	
CT-4.0	CT-4 0 - Sample Nomenclature	Tetra Tech NUS	None	N	

SOPs are located in Appendix G.

CTO 69 031303/P

Revision: 1 Date: September 2014 Worksheet 22 Page 118 of 178

SAP Worksheet #22 -- Field Equipment Calibration, Maintenance, Testing, and Inspection Table

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity ⁽¹⁾	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference ⁽²⁾	Comments
GPS	Positioning	Beginning and end of each day used	Accuracy: sub- meter horizontal dilution of precision (HDOP) <3, number of satellites at least four.	Wait for better signal, replace unit, or choose alternate location technique	Tetra Tech NUS FOL or designee	MRP SOP 05	SOP located in Appendix G
PID	Visual Inspection Calibration/ Verification	Daily Beginning and end of day	Manufacturer's guidance	Operator correction or replacement	Tetra Tech NUS FOL or designee	Operation according to manufacturer's instructions	See manufacturer's instruction included with equipment
Water Quality Meter (YSI 600 Series or Equivalent)	Visual Inspection Calibration/ Verification	Daily Beginning and end of day	Manufacturer's guidance.	Operator correction or replacement	Tetra Tech FOL or designee	SA-1.1 and operation according to manufacturer's instructions	SOP located in Appendix G See manufacturer's instruction included with equipment

Field equipment will be inventoried, inspected, and managed in accordance with procedures described in Worksheet #14 and the SOPs provided in Appendix G.

Activities may include calibration, verification, testing, maintenance, and/or inspection.

2 From the Project Sampling SOP References Table (Worksheet #21).

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date September 2014 Worksheet 23 Page 119 of 178

SAP Worksheet #23 -- Analytical SOP Reference Table (UFP-QAPP Manual Section 3.2.1)

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to Quality Systems Manual (QSM)? (Y/N)	Modified for Project Work? (Y/N)
CA-202	Analysis of Volatile Organic Compounds by Purge and Trap GC/MS: SW-846 Method 8260, 04/14, Revision 15.	Definitive	Soil, sediment, surface water, and aqueous QC samples/ VOCs	Gas Chromatography (GC)/ Mass Spectroscopy (MS)	Katahdin	Z	Ν
CA-213	Analysis of Semivolatile Organic Compounds by: SW-846 Method 8270 – Modified for Selected Ion Monitoring (SIM), 04/14, Revision 12.	Definitive	Soil, sediment, surface water, and aqueous QC samples/ low-level PAHs and 1,4-dioxane	GC/MS	Katahdin	N	N
CA-214	Closed-System Purge-and-Trap and Extraction for Volatile Organics In Soil and Waste Samples Using SW846 Method 5035, 03/12, Revision 6.	Definitive	Soil /VOCs	Tekmar, Arcon, Encon	Katahdin	NA	N
CA-226	Analysis of SVOAs by Capillary Column GC/MS: SW-846 Method 8270D, 04/13, Revision 4.	Definitive	Soil, sediment, surface water, and aqueous QC samples/ SVOCs	GC/MS	Katahdin	N	N
CA-502	Preparation of Aqueous Samples for Extractable Semivolatile Analysis, 05/13, Revision 8.	Definitive	Surface Water and aqueous QC samples / SVOCs and low-level PAHs and 1,4-dioxane extraction	NA/Extraction	Katahdin	NA	N
CA-512	Preparation of Sediment/Soil Samples By Sonication Using Method 3550 for Subsequent Extractable Semi-Volatiles Analysis, (Revision 9, 04/12)	Definitive	Soil and sediment / SVOCs and low-level PAHs and 1,4-dioxane extraction	NA/Extraction	Katahdin	NA	N

031303/P CTO 69

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date September 2014 Worksheet 23 Page 120 of 178

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to Quality Systems Manual (QSM)? (Y/N)	Modified for Project Work? (Y/N)
CA-302	Preparation of Aqueous Samples for Pesticide/PCBs by GC/ECD, Methods3510 and 3520, (04/14, Revision 14).	Definitive	Surface water and aqueous QC samples /pesticides and PCBs	GC/Electron Capture Detector (ECD)	Katahdin	N	N
CA-515	Preparation of Aqueous Samples for Pesticides/PCBs Analysis, (05/13, Revision 9)	Definitive	Surface water and aqueous QC samples /pesticides and PCBs	NA/Extraction	Katahdin	NA	N
CA-526	Preparation of Sediment/Soil Samples by Soxhlet Extraction Using Method 3540 for Subsequent Extractable Semivolatile Analysis, (Revision 8, 04/12).	Definitive	Soil and sediment/ SVOCs and low-level PAHs and 1,4-dioxane extraction	NA/Extraction	Katahdin	NA	N
CA-402	Determination of Nitroaromatics and Nitramines By HPLC Method 8330 (Revision 7, 12/13).	Definitive	Soil, sediment, surface water, and aqueous QC samples/ explosives plus NG	High-Pressure Liquid Chromatography (HPLC)/ Ultraviolet (UV) Detector	Katahdin	N	N
CA-548	Preparation of Aqueous and Solid Samples for Explosive Analysis By Method 8330 (Revision 1, 12/13).	Definitive	Soil, sediment, surface water, and aqueous QC samples/ explosives plus NG extraction	NA/Extraction	Katahdin	N	N
CA-329	Analysis of PCBs as Total Aroclors by GC/ECD, Method 8082 (02/13, Revision 13).	Definitive	Soil and sediment /low-level SVOCs/pesticide and PCBs extraction	GC/ECD	Katahdin	N	Y final extraction volume will be concentra ted to 2 mL

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to Quality Systems Manual (QSM)? (Y/N)	Modified for Project Work? (Y/N)
CA-500	Preparation of Sediment/Soil Samples by Sonication using Method 3550 for subsequent Pesticides/PCBs (04/14, Revision 9).	Definitive	Sediment/soil/ pesticides	NA – Sample Preparation	Katahdin	N	N
CA-524	Preparation of Sediment/soil samples by Soxhlet Extraction using Method 3540 for Pesticides/PCB Analyses, (04/12 Revision 8).	Definitive	Sediment/soil/ pesticides/PCBs	NA – Sample Preparation	Katahdin	N	N
CA-604	Acid Digestion of Aqueous Samples by EPA Method 3010 for ICP and ICP-MS Analysis of Total or Dissolved Metals (Revision 5, 04/10).	Definitive	Surface water and aqueous QC samples/metals digestion	NA – Sample Preparation	Katahdin	NA	N
CA-605	Acid Digestion of Solid Samples by USEPA Method 3050 for Metals by ICP-AES and GFAA (Revision 5, 09/10).	Definitive	Soil and sediment/metals digestion	NA – Sample Preparation	Katahdin	NA	Ν
CA-611	Digestion and Analysis of Solid Samples for Mercury By USEPA Method 7471 (Revision 9, 04/12).	Definitive	Soil and sediment/mercury digestion and analysis	Cold Vapor Atomic Absorption (CVAA)	Katahdin	N	N
CA-615	Digestion and Analysis of Aqueous Samples for Mercury By USEPA Method 7470 (Revision 7, 04/12).	Definitive	Surface water and aqueous QC samples mercury digestion/ analysis	CVAA	Katahdin	N	Ν
CA-627	Trace Metals Analysis By ICP-MS Using USEPA Method 6020 (Revision 9, 04/14).	Definitive	Soil, sediment, surface water, and aqueous field QC samples/metals	ICP-MS	Katahdin	N	Ν

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date September 2014 Worksheet 23 Page 122 of 178

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to Quality Systems Manual (QSM)? (Y/N)	Modified for Project Work? (Y/N)
CA-312	Method for the Determination of Volatile Petroleum Hydrocarbons (MADEP – VPH) (Revision 9, 04/13).	Definitive	Soil, sediment, surface water, and aqueous QC samples/ VPH	GC/ Flame Ionization Detector (FID)/PID	Katahdin	NA	N
CA-322	Method for the Analysis of Extractable Petroleum Hydrocarbons by MADEP – EPH (Revision 11, 04/13).	Definitive	Soil, sediment, surface water, and aqueous QC samples/ EPH	GC/FID	Katahdin	NA	N
CA-511	Extraction of Petroleum Hydrocarbons From Samples for Analysis by MADEP – EPH Methods (Revision 9, 05/13).	Definitive	Soil, sediment, surface water, and aqueous QC samples/ EPH extraction	NA/Extraction	Katahdin	NA	Ν
CA-549	Preparation of sediment/soil samples by microware using Method 3548 subsequent diesel range organics, total petroleum hydrocarbons (TPH), pesticides, PCBs, or Semi-Volatiles Analyses (03/12, Revision 0).	Definitive	Sediment/soil/ for TPH, pesticides/PCBs/ SVOCs	NA – Sample Preparation	Katahdin	N	N
CA-709	pH Concentration Measurements in Soil Matrices Method 9045 (05/12 Revision 9).	Definitive	Waste samples/pH	Accumet Model 20 or equivalent with automatic temperature compensation	Katahdin	N	N
HPLC06	Perchlorate, Method 6850/331.0, 9/15/2012 (Revision 4).	Definitive	Surface water and aqueous QC samples/ Perchlorate	Liquid Chromatography Mass Spectrometry/ Mass Spectrometry (LC/MS/MS)	Microbac	N	N
ALS SOP GEN-7199	Hexavalent Chromium by Ion Chromatography, Rev. 6, 10/14/13	Definiitve	Soil/sediment/surface water and aqueous QC/ Hexavalent Chromium	IC	ALS	NA	N

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date September 2014 Worksheet 23 Page 123 of 178

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to Quality Systems Manual (QSM)? (Y/N)	Modified for Project Work? (Y/N)
ALS SOP GEN-3060	Alkaline Digestion for Hexavalent Chromium in Soil, Rev. 3, 3/1/13	Definitive	Soil/sediment/ Hexavalent Chromium extraction	NA/ Extraction	ALS	NA	N
ALS SOP GEN- REDOX	Redox Potential (Revision 6, 2/24/14)	Definitive	Soil/sediment / ORP	Potentiometer	ALS	NA	N
ALS SOP GEN-9045C	Corrosivity pH by SW-846 9045C (Revision 2, 1/10/11)	Definitive	Soil/sediment/ pH	pH meter	ALS	NA	N

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

Date: September 2014 Worksheet 24 Page 124 of 178

SAP Worksheet #24 -- Analytical Instrument Calibration Table (UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
(ICAL) - A w minimum five- at	Calibrate the instrument when it is received and after a major change or if the daily calibration fails.	VOCs: The average Response Factors (RFs) for System Performance Check Compounds (SPCCs) must be ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane and ≥ 0.10 for chloromethane, 1,1-dichloroethane and bromoform. The Percent RSD (%RSD) for RFs for Calibration Check Compounds (CCCs) must be ≤ 30%, and one option below must be met: Option 1) %RSD < 15% for all other	Repeat calibration if criterion is not met	Analyst, Supervisor	Katahdin CA-202	
		compounds. If not met: Option 2) Linear least squares regression: correlation coefficient (r) \geq 0.995. Option 3) Non-linear regression: coefficient of determination (r ²) \geq 0.99 (six				
	ICV (Second Source)	Once after each ICAL.	points for second order). The %Rs must be 80-120% for all target compounds.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	-
	Retention Time (RT) Window Position Establishment	Once per ICAL for each analyte and surrogate.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial continuing calibration verification is used.	NA	Analyst, Supervisor	
	Evaluation of Relative Retention Times (RRTs)	With each sample.	RRT of each target analyte must be within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Analyst, Supervisor	
	Continuing Calibration Verification (CCV)	Analyze a standard at the beginning of each 12- hour shift after a bromofluorobenzene (BFB) tune.	VOCs: The RFs for SPCCs must be ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane and ≥ 0.10 for chloromethane, 1,1-dichloroethane and bromoform. The %D for all target compounds and	DoD project-level approval must be obtained for each of the failed analytes or CA must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	Analyst, Supervisor	

031303/P CTO 69

Date: September 2014 Worksheet 24 Page 125 of 178

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
GC/MS VOCs (continued)	BFB Tune	Every 12 hours.	Criteria listed in Section 7.3, current revision of SOPs CA-202 and CA-220.	Retune and/or clean source.	Analyst, Supervisor	
GC/MS (full scan) SVOCs GC/MS (SIM) PAHs and 1,4-Dioxane	ICAL - A minimum five-point calibration is required.	Instrument receipt, instrument change (new column, source cleaning, etc.), when CCV is out of criteria. Six-point initial calibration for all analytes.	SVOCs: The average RF for SPCCs must ≥ 0.050 . The %RSD for RFs for CCCs must be $\leq 30\%$, and one option below must be met: Option 1) %RSD < 15% for all other compounds. If not met: Option 2) Linear least squares regression: $r \geq 0.995$ Option 3) Non-linear regression: $r^2 \geq 0.99$ (six points for second order). PAHs - Project-specific criteria: The average RFs for all target compounds must be ≥ 0.050 . The %RSD for all target compounds must be $\leq 30\%$. If not met, Option 2 or Option 3 above must be met.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst, Supervisor	Katahdin CA-226, CA-213
	Breakdown Check (DDT only)	At the beginning of each 12-hour analytical sequence.	The degradation must be ≤ 20% for DDT to verify inertness of the injection port.	Correct the problem then repeat breakdown check. No samples will be run until degradation is ≤20% for DDT.	Analyst, Supervisor	
	ICV (Second Source)	Once after each ICAL.	The %Rs must be 80-120% for all target compounds.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	Katahdin CA-226, CA-213
	RT Window Position Establishment	Once per ICAL for each analyte and surrogate.	Position will be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV will be used.	NA	Analyst, Supervisor	
	Evaluation of RRTs	With each sample.	RRT of each target analyte must be within ± 0.06 RRT units.	Correct problem, then rerun ICAL.	Analyst, Supervisor	
GC/MS (full scan) SVOCs	ccv	Analyze a standard at the beginning of each 12-hour shift after a decafluorotriphenyl-phosphine (DFTPP) tune.	SVOCs: The RF for SPCCs must be ≥0.050; the %Ds for all target compounds and surrogates must be ≤ 20%D PAHs - Project-specific criteria: The RF for all target compounds must be ≥0.050. The %D for all target compounds and surrogates must be ≤ 25%D.	DoD project-level approval must be obtained for each of the failed analytes or CA must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	Analyst, Supervisor	

Date: September 2014 Worksheet 24 Page 126 of 178

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
GC/MS (SIM) PAHs and 1,4-Dioxane (continued)	DFTPP Tune	Every 12 hours	Criteria listed in Section 7.4, current revision of SOPs CA-204 and CA-213	Retune and/or clean source.	Analyst, Supervisor	
PCBs	ICAL - A minimum five-point calibration of Aroclor-1660 (1016/1260 mixture) is prepared.	Upon instrument receipt, major instrument change, when CCV does not meet criteria.	Option 1: %RSD must be ≤20% for Aroclor-1016/1260. If not met, Option 2: r must be ≥ 0.995; or Option 3: r² must be ≥ 0.99 for six-point calibration. Midpoint calibration of other Aroclors – if an Aroclor is detected in a sample, a minimum of five-point ICAL must be performed and meet the above criteria.	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst, Supervisor	Katahdin CA-515, CA-329, CA-500, CA-524, CA-549
	ICV – Second Source	Once after each ICAL prior to sample analysis.	The %Rs of all target analytes must be 80-120% of true value.	Evaluate, repeat, if still failing, recalibrate.	Analyst, Supervisor	
	ccv	Analyze standard at the beginning and end of sequence and after every 10 samples.	The %Ds of all target analytes must be ≤20%.	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval is not received, reanalyze all samples since the last successful CCV.	Analyst, Supervisor	
GC/ECD Pesticides	Breakdown Check - Endrin/DDT	At the beginning of each 12-hour period, prior to analysis of samples.	The degradation must be ≤ 15% for both DDT and Endrin to verify the inertness of the injection port.	Correct the problem then repeat breakdown check. No samples shall be run until degradation is ≤15% for both DDT and Endrin.	Analyst, Supervisor	Katahdin CA-302, CA-500,
	ICAL – A minimum five- point calibration of individual pesticides, with a midpoint calibration of toxaphene and chlordane, is prepared for all target analytes	Upon instrument receipt, major instrument change, or when the CCV does not meet criteria, prior to sample analysis.	The %RSD for RFs for each target analyte must be \leq 20%, or r must be \geq 0.995, or r ² must be \geq 0.99 (minimum of six points required for second order).	Correct problem and repeat ICAL. If a single-point calibration for toxaphene or chlordane is used and toxaphene or chlordane is identified in analysis of a sample, a minimum of a five-point ICAL of the identified compound with reanalysis of sample must be performed. No samples may be run until ICAL has passed.	Analyst, Supervisor	CA-524, CA-549
	ICV – Second Source	Once after each ICAL prior to sample analysis.	The %Rs of all target analytes must be 80-120% of true value.	Correct problem and verify ICV. If that fails, correct problem and repeat ICAL. No samples may be run until ICV has been verified.	Analyst, Supervisor	
	CCV	Analyze standard at the beginning and end of sequence and after every 10 samples.	The %Ds of all target analytes must be ≤20%.	If %D is high and sample result is non-detect, qualify/narrate with project approval. If %D is low or project approval is not received, reanalyze all samples since the last successful CCV.	Analyst, Supervisor	

Revision: 1 Date: September 2014 Worksheet 24 Page 127 of 178

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
ICP-MS – Metals	Tune	Daily prior to calibration	Mass calibration must be within 0.1 atomic mass unit (amu) of true value, Resolution must be < 0.9 amu at 10% peak height. RSD must be ≤ 5% for at least four replicate analyses.	Perform necessary equipment maintenance.	Analyst, Supervisor	Katahdin CA-627, CA-605, CA-608
ICAL	ICAL	Daily prior to sample analysis.	Four-point calibration plus blank – The r must be ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst, Supervisor	
	ICV (Second Source)	Once after each ICAL, and before beginning a sample run.	The %Rs must be within 90-110% of true values for all analytes.	Do not use results for failing elements unless the ICV > 110% and the sample results are non-detect. Investigate and correct problem.	Analyst, Supervisor	
	Calibration Blank	Before beginning a sample sequence, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD. For negative blanks, absolute value < LOD.	Correct the problem, then reprepare and reanalyze.	Analyst, Supervisor	
_	CCV	After every 10 samples, and at the end of each run sequence.	The %Rs must be 90-110% of true value for all analytes.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Supervisor	
	Low-Level Calibration Check Standard	Daily, after one-point ICAL.	The %Rs must be 80-120% of true values for all analytes.	Do not use results for failing elements, unless low-level standard recovery.> upper limit and sample results are non-detect. Investigate and correct the problem.	Analyst, Supervisor	Katahdin CA-627, CA-605, CA-608
	Interference Check Standard (ICS) - ICSA and ICSB	At the beginning of an analytical run and every 12 hours.	The absolute value of ICSA recoveries must be < LOD and ICS B %Rs must be within 80-120 % of the true values.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.	Analyst, Supervisor	
Mercury Analyzer	ICAL	Upon instrument receipt, major instrument change, and at the start of each day.	Initial Calibration, five points plus a calibration blank - r ≥ 0.995.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards.	Analyst, Supervisor	Katahdin CA-611, CA-615
	ICV (Second Source)	Once after each ICAL, prior to beginning a sample run.	The %Rs must be within 90-110% of true value for mercury.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	
	Calibration Blank	Before beginning a sample sequence, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD. For negative blanks, absolute value < LOD.	Correct problem. Reprepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Supervisor	

Date: September 2014 Worksheet 24 Page 128 of 178

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
	CCV	Beginning and end of each run sequence and every 10 samples.	The %Rs must be 90-110% of true value for mercury.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Supervisor	
HPLC/UV - Explosives plus NG	ICAL - A minimum of a five-point calibration curve is analyzed	Prior to sample analysis.	The apparent signal-to-noise ratio at the LOQ must be at least 5:1. If linear regression is used, r must be ≥ 0.995. If Internal Standardization is used, relative RSD for target analytes must be ≤ 15%.	Correct problem, then repeat ICAL. No samples can be run without a valid ICAL.	Analyst, Supervisor	Katahdin CA-548, CA-402
\$	ICV - Second source	Once after each ICAL, prior to beginning a sample run.	The %Rs of all target analytes and surrogates must be within 80-120% of the true values.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. No samples may be run until calibration has been verified.	Analyst, Supervisor	
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates must be ≤20 %D of the expected value from the ICAL.	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since last successful CCV.	Analyst, Supervisor	
GC/FID/PID - VPH	ICAL	Instrument receipt, major instrument change, when CCV does not meet criteria.	The %RSDs of all project compounds must be ≤ 25%.	Investigate and repeat ICAL.	Analyst, Supervisor	Katahdin CA-312
	ICV (Second Source)	Once after each initial calibration.	The %Ds for all project compounds must be ≤25% of the expected values.	(1) Reanalyze standard.(2) Reprepare standard from fresh stock.	Analyst, Supervisor	
	ccv	Analyze prior to sample analysis, after every 20 samples, and at end of sequence.	The %D must be ≤25%.	Evaluate the samples: If the %D >25% (30% for n-nonane) and sample results are <loq, acceptable="" after="" all="" calibration="" last="" narrate.="" otherwise,="" reanalyze="" samples="" td="" verification.<=""><td>Analyst, Supervisor</td><td></td></loq,>	Analyst, Supervisor	
GC/FID - EPH	ICAL	Prior to sample analysis.	The %RSD must be \leq 25% or the r must be \geq 0.99.	Investigate and repeat ICAL.	Analyst, Supervisor	Katahdin CA-322
	ICV (Second Source)	Immediately following calibration.	The %Ds for all project compounds must be ≤25% of the expected values.	Reanalyze standard. Reprepare standard from fresh stock	Analyst, Supervisor	
	CCV	After every 20 samples; if calibration curve previously analyzed, analyze daily before samples.	The %D must be ≤30% for n-nonane and ≤25% for all other analytes. The closing CCV may have four analytes> 25%D but must be < 40%D.	Evaluate the samples: If the %D >25% (30% for n-nonane) and sample results are < LOQ, narrate. Otherwise, reanalyze all samples after last acceptable CCV.	Analyst, Supervisor	
LC/MS Perchlorate	Mass Calibration	Upon instrument set-up and as needed	±0.3 m/z of mass 83, 85, and 89	Correct the problem and recalibrate	Analyst/ Supervisor	Microbac HPLC06

Revision: 1 Date: September 2014 Worksheet 24 Page 129 of 178

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
	ICAL	Prior to sample analysis	RSD for each analyte ≤ 20% or r > 0.995. The concentration corresponding with the y-intercept must be ≤LOD.	Correct problem then repeat ICAL	Analyst/ Supervisor	
	ICV	After each ICAL; analysis of second source standard at midpoint of calibration	85-115% Recovery	Correct problem and verify second source standard. Rerun ICV, if that fails, correct problem and repeat ICAL.	Analyst/ Supervisor	
	CCV	At the beginning of the analytical sequence; after each 10 field samples; at the end of the analytical sequence	85-115% Recovery	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst/ Supervisor	
	ICS	One per batch of 20 samples; at least one daily	Must be within 30% of true value	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.	Analyst/ Supervisor	
IC/UVVIS – hexavalent chromium	ICAL	Prior to sample analysis	CC > 0.999	Correct problem then repeat ICAL	Analyst / Supervisor	ALS SOP GEN-7199
	ICV	After each ICAL	90-110% Recovery	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst / Supervisor	
	CCV	At the beginning of the analytical sequence; after each 10 field samples; at the end of the analytical sequence	90-110% Recovery	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst / Supervisor	
pH Meter	ICAL	Calibrate daily before use with two to three buffers	0.05 pH units.	Recalibrate and/or perform necessary equipment maintenance.	Analyst/Supervisor	ALS SOP GEN-9045C

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

Date: September 2014 Worksheet 24 Page 130 of 178

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
	ccv	Every 20 samples and at the end of each analytical sequence.	0.05 pH units of the true value	Reanalyze the CCV using a new aliquot. If the result is still not compliant, then recalibrate the meter and re-analyze all of the samples after the last compliant CCV	Analyst/Supervisor	
Potentiometer	ICAL	Calibrate daily before use, using 2 reference solutions.	Results must be within 15% of the true value.	Recalibrate and/or perform necessary equipment maintenance.	Analyst/Supervisor	ALS SOP GEN-REDOX
	CCV	Every 20 samples and at the end of each analytical sequence.	Results must be within 15% of the true value.	If the value of the reference solution exceeds 15% of the true value, correct the problem and reanalyze the affected samples, (bound by the out of control reference).	Analyst/Supervisor	

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date September 2014 Worksheet 25 Page 131 of 178

SAP Worksheet #25 -- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
GC/MS	Check pressure and gas supply daily. Bake out trap and column, manual tune if BFB not in criteria, change septa as needed, cut column as needed, change trap as needed. Other maintenance specified in lab Equipment Maintenance SOP.	VOCs	lon source, injector liner, column, column flow, purge lines, purge flow, trap	Prior to ICAL and/or as necessary	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	CA-202
GC/MS	Check pressure and gas supply daily. Manual tune if DFTPP not in criteria, change septa as needed, change liner as needed cut, column as needed. Other maintenance specified in lab Equipment Maintenance SOP	SVOCs/PAHs and 1,4- Dioxane	lon source, injector liner, column, column flow	Prior to ICAL and/or as necessary	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	CA-213, CA-226
GC/ECD	Check pressure and gas supply daily. Bake out column, change septa, and/or liner as needed, replace, or cut column as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Pesticides and PCBs	Injector liner, septa, column, column flow.	Prior to ICAL and/or as necessary.	Acceptable ICAL and CCV.	If %D > 20% and samples are < LOD, narrate. If %D > 20% only on one column, narrate. If %D > 20% for closing CCV and is likely due to matrix interference, narrate. Otherwise, reanalyze all samples since the last acceptable CCV.	Analyst, Supervisor	CA-302, CA- 329
ICP-MS	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Metals	Torch, nebulizer, spray chamber, pump tubing	Prior to ICAL and as necessary	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	CA-627
Mercury Analyzer	Replace peristaltic pump tubing, replace mercury lamp, replace drying tube, clean optical cell, and/or clean liquid/gas separator as needed. Other maintenance specified in lab Equipment Maintenance SOP.	Mercury	Tubing, sample probe, optical cell	Prior to ICAL and as necessary	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	CA-611, CA-615

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
HPLC/UV	Check and sonicate pump valves as needed. Backflush column as needed. Replace analytical column or guard column as needed. Sonicate and replace solvent with every use. Replace the UV lamp as needed. Check and replace seal-pak as needed.	Explosives plus NG	Column flow, pressure	Prior to ICAL and as necessary	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	CA-402
GC/PID/FID	Replace or cut GC column as needed. Bake out trap and column. Change trap as needed.	VPH	Trap, column, column flow	Prior to ICAL and/or as necessary	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	SOP CA-312
GC/FID	Check pressure and gas supply daily. Change septa and/or GC injector glass liner as needed. Replace or cut GC column as needed. Other maintenance specified in lab Equipment Maintenance SOP.	ЕРН	Injector liner, septa, column, column flow	Prior to ICAL and/or as necessary	Acceptable ICAL or CCV	Correct the problem and repeat ICAL or CCV.	Analyst, Supervisor	SOP CA-322
LC/MS	Change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Perchlorate	Check pump pressure, check for leaks, check for adequate mobile phase	Instrument receipt, instrument change (new column, etc.), when CCV does not meet criteria	Acceptable ICAL and CCV.	Correct the problem and repeat ICAL or CCV.	Analyst/ Supervisor	HPLC06
IC/UVVIS	Change column bed supports; Clean Column; Change Column; Change Tubing	Hexavalent Chromium	Change column bed supports, Clean column, Change column, Change tubing	Column bed supports and clean column monthly or as needed; change column every 6 months or as needed; change tubing annually or as needed	must meet initial and/or continuing calibration criteria	Repeat maintenance activity or remove from service	Analyst/ Supervisor	ALS SOP GEN-7199
mV meter	NA	ORP as Eh	Blot electode dry, equilibrate in air.	Daily	NA.	Clean electrodes per manufacturer / SOP or remove from service.	Analyst, Supervisor	ALS SOP GEN-REDOX
pH meter	NA	рН	Visual inspection of probe.	Each use.	NA.	Remove from service.	Analyst, Supervisor	ALS SOP GEN-9045C

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

> Date: September 2014 Worksheet 26 Page 133 of 178

SAP Worksheet #26 -- Sample Handling System

(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection (Personnel/Organization): FOL or designee / Tetra Tech

Sample Packaging (Personnel/Organization): FOL or designee / Tetra Tech

Coordination of Shipment (Personnel/Organization): FOL or designee / Tetra Tech

Type of Shipment/Carrier: Overnight courier service (FedEx)

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): Sample Custodians / Katahdin / Microbac / ALS

Sample Custody and Storage (Personnel/Organization): Sample Custodians / Katahdin / Microbac / ALS

Sample Preparation (Personnel/Organization): Preparation laboratory staff / Katahdin /Microbac / ALS

Sample Determinative Analysis (Personnel/Organization): HPLC Lab, and ICP-MS Lab personnel / Katahdin / Microbac / ALS

SAMPLE ARCHIVING

Field Sample Storage (Number of days from sample collection): 60 days from submittal of final report

Sample Extract/Digestate Storage (number of days from extraction/digestion): 60 days from submittal of final lab report

Biological Sample Storage (Number of days from sample collection): NA

SAMPLE DISPOSAL

Personnel/Organization: Sample Custodians/Katahdin / Microbac / ALS

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI

Revision: 1

Date: September 2014 Worksheet 27

Page 134 of 178

SAP Worksheet #27 – Sample Custody Requirements Table

(UFP-QAPP Manual Section 3.3.3)

Field Sample Custody Procedures

Katahdin, Microbac, and ALS will provide pre-preserved sample containers for sample collection (as

required). Following sample collection into the appropriate bottleware, all samples will be immediately

placed on ice in a cooler. Glass sample containers will be enclosed in bubble wrap to protect the

bottleware during shipment. The cooler will be secured using strapping tape and a signed custody seal.

Sample coolers will be delivered to a local courier location for priority overnight delivery to the selected

laboratory for analysis or picked up on location by the selected laboratory. Samples will be preserved as

appropriate based on the associated analytical method. Samples will be maintained at less than 6 °C

(but not frozen) until delivery to the laboratory. Chain-of-custody protocols will be used throughout

collection and sample handling to establish the evidentiary integrity of samples. These protocols will be

used to demonstrate that the samples were handled and transferred in a manner that would eliminate

possible tampering. Samples for the laboratory will be packaged and shipped in accordance with SA-6.1.

Chain-of-Custody Procedures

After collection, each sample will be maintained in the sampler's custody until formally transferred to

another party (e.g., FedEx). For all samples collected, chain-of-custody forms will document the date and

time of sample collection, sampler's name, and names of all others who subsequently held custody of the

sample. Specifications for chemical analyses will also be documented on the chain-of-custody form.

MRP SOP 05 provides further details on chain-of-custody procedures. Chain-of-custody requirements

are also documented with instructions contained in each shipment from the laboratory.

Laboratory Sample Custody Procedures

The laboratory sample custody procedures (receipt of samples, archiving, and disposal) documented in

Katahdin, Microbac, and ALS SOPs will be followed. Coolers will be received and checked for proper

temperature. A sample cooler receipt form will be completed to note conditions and any discrepancies

between the cooler contents and the chain-of-custody form. The chain-of-custody form will be compared

to the sample containers received to verify correctness. Samples will be logged into the Laboratory

Information Management System (LIMS) and assigned a unique log number that can be tracked through

processing. The Tetra Tech PM or Project Chemist will be notified of any problems by the Katahdin,

Microbac, and ALS Laboratory PMs on the same day that the issue is identified.

031303/P CTO 69

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI

Revision: 1

Date: September 2014 Worksheet 27

Page 135 of 178

Sample Designation System

Each sample collected for analysis will be assigned a unique sample tracking number. This number will

consist of a three-segment alphanumeric code that identifies the site and a two or three-segment

alphanumeric code that identifies the DU and sample type (sample medium or QC sample designation).

A three-segment number will indicate the sample location and a four-segment number will identify the

sample depth indicator. SOP CT-4.0 addresses sample identification nomenclature not described below.

All pertinent information regarding sample identification will be recorded in the field logbooks and on

sample log sheets where appropriate.

The alphanumeric coding system to be used is as follows:

Site Identifier:

QRY = Quarry Area

Sample Medium:

SB = Surface/subsurface soil from soil borings or test pits

T = Subsurface soil from trench excavations

SD = Sediment

SW = Surface water

QA/QC Sample Designation:

RB = Rinsate blank

FD = Field duplicate

TB = Trip blank

Sample Location:

All planned sample location numbers are identified in Worksheet #18.

Surface and subsurface soil samples from hand auger or DPT borings or test pits will be assigned a two-

digit consecutive location number. This will then be followed by the soil sample depth indicated by a four-

digit number. The first two digits will represent the upper limit of the sample depth interval (rounded to the

nearest foot), and the last two digits will represent the lower limit of the sample depth interval

(e.g., QRY-SB21-0103).

031303/P CTO 69

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI

for Soli/Sediment/Surface Water RI

Revision: 1

Date: September 2014 Worksheet 27 Page 136 of 178

Sediment samples will be assigned a two-digit consecutive location number. For sediment samples, the

two-digit location number will be followed by the sample depth indicated by a four-digit number. The first

two digits will represent the upper limit of the sample depth, and the last two digits will represent the lower

limit of the sample depth interval (depths will be rounded to the nearest 0.5 foot represented as X.5)

(e.g., QRY-SD01-0.501).

Surface water samples will be assigned a two-digit consecutive location number, corresponding with the

collocated sediment sample. Appended to this will be a four-digit code in MMYY format to indicate the

month (MM) and year (YY) in which the sample was collected (QRY-SW03-1014).

QC Sample Number:

All QC samples will be assigned a sequential sample number. For example, the first equipment rinsate

blank collected October 16, 2014, will be assigned the tracking number 12RB101614-01. Field duplicate,

MS, and MSD samples will be collected from the same location. The field duplicate will be given the

same type of sample designation as the associated samples so that it will be "blind" to the laboratory

(QRY-SD-XX where XX is the sequential duplicate number). The sampling time recorded on the chain-of-

custody form, labels, and tags for the duplicate samples will be 0000. Notes detailing the sample

number, time, date, and type for each duplicate sample will be recorded on the routine sample log sheet

and will document the location of the duplicate sample (sample log sheets are not provided to the

laboratory).

All pertinent information regarding sample identification will be recorded in the field logbooks and on

sample log sheets, where appropriate.

031303/P CTO 69

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

Date: September 2014 Worksheet 28 Page 137 of 178

SAP Worksheet #28 -- Laboratory QC Samples Table (UFP-QAPP Manual Section 3.4)

Matrix	Soil, sediment, surface water, and aqueous QC samples					
Analytical Group	VOCs					
Analytical Method/ SOP Reference	SW-846 8260B/ CA-202					
QC Sample	Frequency/ Number	Method/SOPQC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per batch of 20 or less.	must be ≤ ½ LOQ, except common lab contaminants, which must be < LOQ.	Investigate source of contamination. Rerun method blank prior to analysis of samples if possible. Evaluate the samples and associated QC; if blank results are greater than LOQ, report sample results that are < LOQ or > 10X the blank concentration. Reanalyze blank and samples > LOQ and < 10X the blank.	Analyst, Supervisor	Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.

031303/P CTO 69

Date: September 2014 Worksheet 28 Page 138 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples					
Analytical Group	VOCs					
Analytical Method/ SOP Reference	SW-846 8260B/ CA-202					
QC Sample	Frequency/ Number	Method/SOPQC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogate	Four per sample: Dibromofluoro- methane, 1,2- dichloroethane-d4, Toluene-d8, Bromofluorobenzene	%Rs must meet the DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM.	If sample volume available, and within hold time, reanalyze.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Laboratory Control Sample (LCS)	One per batch of 20 or less.	%Rs must meet the DoD QSM for Environmental Laboratories, Version 4.2, limits per Appendix G of the DoD QSM. RPD must be ≤ 30% (for LCS/Laboratory Control Sample Duplicate [LCSD], if LCSD is performed). In-house statistical laboratory limits are used when DoD QSM, Version 4.2, does not specify.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact Tetra Tech if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 139 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples					
Analytical Group	VOCs					
Analytical Method/ SOP Reference	SW-846 8260B/ CA-202					
QC Sample	Frequency/ Number	Method/SOPQC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Internal Standard (IS)	Four per sample- Pentafluorobenzene 1,4-Difluorobenzene, Chlorobenzene-d5 1,4-dichlorobezene-d4	± 30 seconds and the responses within -50% to	Inspect MS or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
MS/MSD	One per Sample Delivery Group (SDG) or every 20 samples.	%Rs should meet the DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. RPD must be ≤ 30%	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met. If both the LCS and MS/MSD are unacceptable, reprepare the samples and QC.	Analyst, Supervisor	Precision/ Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1

Date: September 2014 Worksheet 28 Page 140 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples
Analytical Group	SVOCs (including low-level PAHs and 1,4-dioxane)
Analytical Method/ SOP	SW-846 8270D/8270D SIM/
Reference	CA-226, CA-213

Reference		CA-226, CA-213				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
		should be > ½ the LOQ.			Accuracy/Bias/Contamination	Same as Method/SOP QC Acceptance Limits.

031303/P CTO 69

Date: September 2014 Worksheet 28 Page 141 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples
Analytical Group	SVOCs (including low-level PAHs and 1,4-dioxane)
Analytical Method/ SOP	SW-846 8270D/8270D SIM/

Reference		CA-226, CA-213				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Surrogates	Six per sample (scan): 2-Fluorophenol Phenol-d6 Nitrobenzene-d5 2-Fluorobiphenyl 2,4,6- Tribromophenol Terphenyl-d14 three per sample (SIM) 2- methylnaphthalene-d10, Fluorene-d10, Pyrene-d10.	%Rs must meet the DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. SIM surrogate recoveries within laboratory control limits.	•	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

031303/P CTO 69

Date: September 2014 Worksheet 28 Page 142 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples
Analytical Group	SVOCs (including low-level PAHs and 1,4-dioxane)
Analytical Method/ SOP	SW-846 8270D/8270D SIM/

Reference		CA-226, CA-213				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
LCS		%Rs must meet the DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. RPD must be ≤ 30% (for LCS/LCSD, if LCSD is performed). In-house statistical laboratory limits are used when DoD, QSM Version 4.2, does not specify.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available Contact Tetra Tech if samples cannot be reanalyzed within hold time.		Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
IS	1,4- Dichlorobenzene-d4	RTs for ISs must be ± 30 seconds and the responses within -50% to +100% of last calibration verification (12 hours) for each IS.	Reanalyze affected samples.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Revision: 1

Date: September 2014 Worksheet 28 Page 143 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples
Analytical Group	SVOCs (including low-level PAHs and 1,4-dioxane)
Analytical Method/ SOP	SW-846 8270D/8270D SIM/
Reference	CA-226, CA-213

Reference		CA-226, CA-213				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
MS/MSD	One per SDG or every 20 samples.	DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. RPD should be ≤ 30%. In-house statistical laboratory limits are	taken for samples		Precision/Accuracy/ Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.		Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 144 of 178

OC Comple	Eroguanay/ Number	Method/SOP QC	CA		
		CA-605			
		608, CA-604, CA-611	, CA-615, CA-627, CA-604/		
Analytical Met		SW-846 6010, 6020A,7470A, 7471B, 3050/ CA-			
Analytical Gro	up	Metals (including me	rcury)		
Analytical Cro	un.	Motala (including ma	rour ()		
		samples			
Matrix		Soil, sediment, surface	ce water, and aqueous QC		

		CA-605				
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per digestion batch of 20 or fewer samples.	No analytes detected > 1/2 the LOQ.	Correct the problem. If method blank is >½ the LOQ, then: 1) Report sample results that are <lod or="" results="" sample="">10x the blank concentration without CA. 2) For samples with results > LOD and < 10x the contaminated blank result, reprepare/ redigest and reanalyze the method blank and associated samples.</lod>		Accuracy/Bias/ Contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per digestion batch of 20 or fewer samples.	Water and soil sample %Rs must be between 80 and 120%.	Redigest and reanalyze all associated samples for affected analyte.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Duplicate Sample	One per preparation batch of 20 or fewer samples of similar matrix.	The RPD should be ≤20% for duplicate samples for both water and soils.	Narrate any results that are outside control limits.	Analyst, Supervisor	Precision	Same as Method/SOP QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 145 of 178

OC Comple	Eroguanay/ Number	Method/SOP	QC	CA	
		CA-605			
		608, CA-604, CA	۱ - 611,	CA-615, CA-627, CA-604/	
Analytical Met		SW-846 6010, 6020A,7470A, 7471B, 3050/ CA-			
	•	, , , , , ,	,	,,	
Analytical Gro	up	Metals (including mercury)			
		samples			
Matrix	Soil, sediment, surface water, and aqueous QC				

		CA-605	071 010, 071 021, 071 00-7			
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
MS	One per digestion batch of 20 or fewer samples.	%R should be 80- 120% if sample < 4x spike added.	Flag results for affected analytes as estimated	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
IS (applies to SW-846 6020A only)	Every sample.	For each sample, IS intensity must be 30-120% of that of initial calibration standard.	Reanalyze affected samples.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
ICP Serial Dilution	One per preparation batch of 20 or fewer samples of similar matrix.	If original sample result is at least 50x the instrument detection limit, five-fold dilution must agree within ± 10% of the original result.	Flag results for affected analytes for all associated samples as estimated	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Post-Digestion Spike (does not apply to mercury)	One is performed when serial dilution fails or target analyte concentration(s) in all samples are < 50x LOD.	The %R must be 75- 125% of expected value to verify the absence of an interference. Spike addition should produce a concentration of 10 to 100x LOQ.	Flag results of samples of same matrix as estimates in SDG narrative.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Wati ix	water, and aqueous QC samples					
Analytical Group	Explosives plus NG					
Analytical Method/ SOP Reference	SW-846 8330B CA-402					
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per batch of 20 or fewer samples per matrix.	No analytes ≥½ LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.	Analyst, Supervisor	Bias/Contamination	Same as QC Acceptance Limits.
Surrogates	All field and QC samples. One per sample: 1,2-Dinitrobenzene	%Rs must be within 30-150%.	Investigate the problem. If the recovery looks like it is affected by the sample matrix, the sample may be reinjected to confirm matrix interference. When the sample has no detectable surrogate recovery, the sample should be re-extracted.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.
LCS/LCSD (LCSD not required)	One per batch of 20 or fewer samples per matrix.	%R for target analytes must be within DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. In-house statistical laboratory limits are used when DoD QSM, Version 4.2, does not specify.	Correct problem then re-prepare and reanalyze LCS and all samples processed with the failed analytes. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.	Analyst, Supervisor	Accuracy/Bias; Precision also, if LCSD is analyzed	Same as QC Acceptance Limits.
MS/MSD	One per batch of 20 or fewer samples per matrix.	%R for target analytes should be within DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. RPD between MS and MSD	Evaluate the sample spiked for matrix interference, and flag the data as necessary. Examine the project DQOs, and the Laboratory PM will contact the Tetra Tech Project	Analyst, Supervisor	Accuracy/Bias Precision	Same as QC Acceptance Limits.

Matrix

Soil, sediment, surface

031303/P

action.

should be ≤20%.

specify.

In-house statistical laboratory limits are used when DoD QSM, Version 4.2, does not

Chemist to determine the course of

Date: September 2014 Worksheet 28 Page 147 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples					
Analytical Group	Explosives plus NG					
Analytical Method/ SOP Reference	SW-846 8330B CA-402					
QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Second Column Confirmation	All positive results must be confirmed.	Results between primary and second column - RPD must be ≤ 40%.	None. Report from both columns. Apply "J" flag if RPD >40% and discuss in the case narrative.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.
Results between the DL and LOQ	NA.	Apply "J" qualifier to results detected between DL and LOQ.	None.	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 148 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples					
Analytical Group	TCL Pesticides/					
	PCBs					
Analytical Method/ SOP Reference	SW-846 8081B, 8082A, 3550, 3540/CA-329, CA- 500, CA-524					
QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ ½ LOQ.	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits
LCS	One per preparatory batch of 20 or fewer samples of similar matrix. Pesticides: Spike with single component pesticide mix. PCBs: Spike with Aroclor-1016/1260 mix.	%Rs must meet the DoD QSM, Version 4.2, limits, per Appendix G of the DoD QSM.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Contact client if samples cannot be reanalyzed within hold time.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits
MS/MSD	One per preparatory batch of 20 or fewer samples of similar matrix. Spike same as LCS.	%Rs must meet the DoD QSM Version 4.2 limits as per Appendix G of the DoD QSM. The RPD between MS and MSD should be ≤ 30%.	Evaluate the samples and associated QC and if the LCS results are acceptable, then narrate. If both the LCS and MS/MSD are unacceptable, then re-prepare the samples and QC.	Analyst, Supervisor	Accuracy/Bias/ Precision	Same as QC Acceptance Limits
Surrogates	All field and QC samples - two per sample: Tetrachloro-m-xylene Decachlorobiphenyl.	%Rs must meet the DoD QSM, Version 4.2, limits per Appendix G of the DoD QSM. In-house statistical laboratory limits are used when DoD QSM, Version 4.2, does not specify.	No corrective will be taken when one surrogate is within criteria. If surrogates recoveries are high and sample is <loq, affected="" and="" are="" ca="" if="" is="" low,="" no="" re-extract="" reanalyze="" recoveries="" samples.<="" surrogates="" taken.="" td="" the="" then=""><td>Analyst, Supervisor</td><td>Accuracy/Bias</td><td>Same as QC Acceptance Limits</td></loq,>	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits
Results between DL and LOQ	NA	Apply "J" qualifier to results between DL and LOQ.	NA	Analyst, Supervisor	Accuracy	Same as QC Acceptance Limits

Date: September 2014 Worksheet 28 Page 149 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples
Analytical Group	VPH
Analytical Method/ SOP Reference	MADEP VPH/ Katahdin SOP CA- 312

QC Sample Frequency/ Number A		Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC	
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ LOQ.	Investigate source of contamination. Evaluate the samples and associated QC, i.e., if the blank results are greater than the LOQ, report samples results that are < LOQ and >10X the blank. Otherwise, reprepare a blank and the remaining samples.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits.	
Surrogates	Every field and QC sample. One per sample: 2,5- Dibromotoluene	Water and soil: %Rs must be 70- 130%.	Reanalyze; present both sets of data.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.	
LCS LCSD (not required)	One per preparation batch of 20 or fewer samples of similar matrix.	Water and soil: %Rs must be 70- 130%.	Evaluate the samples and associated QC, i.e. if an MS/MSD was performed and acceptable, narrate. If an LCS/LCSD was performed and only one of the set was unacceptable, narrate. If the surrogate recoveries in the LCS are low but are acceptable in the blank and samples, narrate. If the LCS recovery is high but the sample results are < LOQ, narrate. Otherwise, reprepare a blank and the remaining samples.	Analyst, Supervisor	Accuracy/Bias: Precision also, if LCSD analyzed	Same as QC Acceptance Limits.	
MS/MSD	One per SDG or every 20 samples.	Water and soil: %Rs should be 70- 130%. RPD between MS and MSD should be ≤50%.	Evaluate the samples and associated QC, i.e. If the LCS results are acceptable, narrate. If both the LCS and MS/MSD are unacceptable, reprepare the samples and QC.	Analyst, Supervisor	Accuracy/Bias/ Precision	Same as QC Acceptance Limits.	

Date: September 2014 Worksheet 28 Page 150 of 178

Matrix	Soil, sediment, surface water, and aqueous QC samples
Analytical Group	EPH
Analytical Method/ SOP Reference	MADEP EPH/ Katahdin SOP CA- 322
	_ ,

QC Sample	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	MPC
Method Blank	One per preparation batch of 20 or fewer samples of similar matrix.	All target analytes must be ≤ LOQ.	Investigate source of contamination. Evaluate the samples and associated QC, i.e., if the blank results are greater than the LOQ, report samples results that are < LOQ and >10X the blank. Otherwise, reprepare a blank and the remaining samples.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits.
Surrogates	Every field and QC sample. Three per sample: ortho-Terphenyl, 5-alpha-Androstane, 2-Fluorobiphenyl	Water and soil: %Rs must be 40- 140%.	Reanalyze; present both sets of data.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.
LCS LCSD (not required)		Water and soil: %Rs must be 40- 140%. RPD between LCS and LCSD must be ≤ 25%, if analyzed.	Evaluate the samples and associated QC, i.e. if an MS/MSD was performed and acceptable, narrate. If an LCS/LCSD was performed and only one of the set was unacceptable, narrate. If the surrogate recoveries in the LCS are low but are acceptable in the blank and samples, narrate. If the LCS recovery is high but the sample results are < LOQ, narrate. Otherwise, reprepare a blank and the remaining samples.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.
MS/MSD	One per SDG or every 20 samples.	Water and soil: %Rs should be 40- 140%. RPD should be ≤ 50%.	Evaluate the samples and associated QC, i.e. if the LCS is acceptable, narrate. If both the LCS and MS/MSD are unacceptable, reprepare the samples and QC.	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 151 of 178

Matrix	Surface water and aqueous QC					
Analytical Group	Perchlorate					
Analytical Method/ SOP Reference	SW-846 6850/331.0/ Microbac SOP- HPLC06					
QC Sample	Frequency/ Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per batch of 20 samples	No perchlorate detected > 1/2 QL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > QL.	If all samples below 1/2 QL, no CA. Otherwise, reprep and reanalyze all samples processed with contaminated blank.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
LCS	One per batch of 20 samples	See limits on Worksheet #15-6	No CA, if recovery is high and perchlorate is not detected above the QL in the samples. Otherwise, reanalyze all samples.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
(MS/MSD	1 per batch of 20 samples if client designated	See limits on Worksheet #15-6	No action required.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 152 of 178

Matrix	Surface water and aqueous QC					
Analytical Group	Perchlorate					
Analytical Method/ SOP Reference	SW-846 6850/331.0/ Microbac SOP- HPLC06					
QC Sample	Frequency/ Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
IS	Every sample	Measured ¹⁸ O IS area within ±50% of the value from the avg of the IS area counts of the ICAL. RRT of perchlorate ion must be 1.0±2% (0.98-1.02)	Reanalyze sample at increasing dilutions until ±50% acceptance criteria met. If not met, reprep samples.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Isotope Ratio ³⁵ CL / ³⁷ CL	Every sample	Monitor for either parent ion at masses 99/101 or daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~ 3.06. Must fall within 2.3 to 2.8.	Sample must be reanalyzed.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.
Limit of detection verification (LODV)	One per batch of 20 samples	Within + 30% of true value.	Correct problem. Rerun LODV and all samples since last successful LODV.	Analyst, Supervisor	Accuracy/Bias	Same as Method/SOP QC Acceptance Limits.

Revision: 1 Date: September 2014 Worksheet 28 Page 153 of 178

Matrix Analytical Group Analytical	Surface water and aqueous QC Hexavalent Chromium SW-846 7199 /					
Method/S OP Reference	ALS SOP GEN- 7199					
QC Sample	Frequency/ Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	1 per batch of 20 or fewer samples.	No target compounds should be >1/2 LOQ	Reclean, reanalyze and/or qualify the data.	Analyst, Supervisor	Bias/ Contamination	Same as QC Acceptance Limits.
MS	1 per batch of 20 or fewer samples.	34-154% of True Value.	If LCS acceptable, may report with qualifier and note outliers in the case narrative.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.
LCS	1 per batch of 20 or fewer samples.	85-115% of True Value.	Evaluate, reanalyze batch if possible. If the LCS recoveries are high and the sample results are <ql narrate.<="" td=""><td>Analyst, Supervisor</td><td>Accuracy/ Bias</td><td>Same as QC Acceptance Limits.</td></ql>	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.
DUP (or MSD)	1 per batch of 20 or fewer samples.	RPD<20%; +/- RL if <4xLOQ.	Repeat sample and duplicate unless obvious or historical interferences or lack of volume.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 154 of 178

Matrix	Soil and sediment
Analytical Group	Hexavalent Chromium
Analytical Method/SOP Reference	SW-846 7199/ ALS SOP GEN-7199

QC Sample Method Blank	Frequency/Number 1 per batch of 20 or fewer samples	Method/SOP QC Acceptance Limits No target compounds should be >1/2 LOQ.	CA Reclean, reanalyze and/or qualify the data	Person(s) Responsible for Corrective Action Analyst, Supervisor	DQI Bias/ Contamination	MPC Same as QC Acceptance Limits.
MS-soluble	1 per batch of 20 or fewer samples	75-125% of True Value.	Redigest entire batch unless spike is diluted out (sample result > 4x spike concentration). If redigest fails, contact client about possible matrix investigations. If samples are out of holding time, redigest and report both sets of data. If insufficient sample is available to redigest, flag. Flag results associated with out of control matrix spike.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 155 of 178

Matrix	Soil and sediment		
Analytical	Hexavalent		
Group	Chromium		
Analytical	SW-846 7199/ ALS		
Method/SOP	SOP GEN-7199		
Reference	001 021(7100		

Reference	SOP GEN-7199	Method/SOP QC		Person(s)		
QC Sample	Frequency/Number	Acceptance Limits	CA	Responsible for Corrective Action	DQI	MPC
MS-insoluble	1 per batch of 20 or fewer samples	75-125% of True Value.	Redigest entire batch unless spike is diluted out (sample result > 4x spike concentration). If redigest fails, contact client about possible matrix investigations. If samples are out of holding time, redigest and report both sets of data. If insufficient sample is available to redigest, flag. Flag results associated with out of control matrix spike.	Analyst, Supervisor	Accuracy/ Bias	Same as QC Acceptance Limits.
LCS-insoluble	1 per batch of 20 or fewer samples	82-120% of True Value.	Redigest if possible. If samples are out of holding time, redigest and report both sets of data. If insufficient sample is available to redigest, flag. If the LCS recoveries are high and the sample results are <ql narrate.<="" td=""><td>Analyst, Supervisor</td><td>Accuracy/Bias</td><td>Same as QC Acceptance Limits.</td></ql>	Analyst, Supervisor	Accuracy/Bias	Same as QC Acceptance Limits.
DUP (or MSD)	1 per batch of 20 or fewer samples	RPD<20%; +/- RL if <4xLOQ.	Repeat sample and duplicate unless obvious or historical interferences or lack of volume.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.

Date: September 2014 Worksheet 28 Page 156 of 178

Matrix	Soil and sediment
Analytical	Hexavalent
Group	Chromium
Analytical	SW-846 7199/ ALS
Method/SOP	SOP GEN-7199
Reference	

QC Sample	I-radiiancy/Niimhar	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for Corrective Action	DQI	MPC
Post Digestion Matrix Spike	1 per batch of 20 or fewer samples	85-115% of True Value	If MS also failed, no action beyond CA for MS.	Analyst, Supervisor	Bias	Same as QC Acceptance Limits.

Revision: 1 Date: September 2014 Worksheet 28 Page 157 of 178

Matrix	Soil and sediment					
Analytical Group	ORP (as Eh)					
Analytical Method / SOP Reference	ASTM D1498/ALS SOP GEN-REDOX					
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
LCS	One for every 20 samples.	LCL UCL - 30mV +30mV	Obtain an acceptable LCS and reanalyze all associated samples.	Analyst, Supervisor	Accuracy/ Blas	Same as Acceptance Criteria
Dup	One for every 20 samples.	< or = to 20 RPD	Note outlier in case narrative.	Analyst, Supervisor	Precision	Same as Acceptance Criteria

Revision: 1

Date: September 2014 Worksheet 28 Page 158 of 178

Laboratory Duplicate	One per preparation batch of 20 or fewer samples.	<u>+</u> 0.1 units	Correct problem, reprepare and reanalyze along will associated samples.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits		Person(s) Responsible for CA	DQI	мрс
Analytical Method / SOP Reference	SW-846 9045C/ ALS-SOP GEN- 9045C			1	Γ	
Analytical Group	рН					
Matrix	Soil and sediment					

Date: September 2014 Worksheet 29 Page 159 of 178

SAP Worksheet #29 -- Project Documents and Records Table (UFP-QAPP Manual Section 3.5.1)

Document	Location Maintained
Sample Collection Documents and Records: Field logbook (and sampling notes) Field sample forms (e.g., boring logs, sample log sheets, drilling logs, etc.) Chain-of-custody records Sample shipment airbills Equipment calibration logs Photographs FTMR forms SAP Field Sampling SOPs HASP	Tetra Tech project file; results will be discussed in subject document.
Laboratory Documents and Records in the Form of Analytical Data Packages: Sample receipt/login forms Sample storage records Sample preparation logs Equipment calibration logs Sample analysis run logs Reported results for standards, QC checks, and QC samples Data completeness checklists Telephone logs Extraction/clean-up records Raw data EDDs	Tetra Tech project file; data will be uploaded to NIRIS. Laboratory documents will be included in the hardcopy and Portable Document Format (PDF) deliverables from the laboratory. Laboratory data deliverables will be maintained in the Tetra Tech project file and in long-term data package storage at a third-party professional document storage firm. Electronic data results will be maintained in a database on a password-protected Structured Query Language (SQL) server.

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Revision: 1 Date: September 2014 Worksheet 29 Page 160 of 178

Document	Location Maintained
Other Documents:	Tetra Tech project file; final reports will be uploaded to NIRIS. All versions of the reports and all support documents (e.g., Data Validation Reports) will be stored in hardcopy in the Tetra Tech project file and electronically in the server library.
 Data Validation Reports (includes tabulated data summary forms) All versions of project reports RI Report NAS Brunswick Quarry Area 	

Data Management

The principal data generated for this project will be field data and laboratory analytical data. Field sampling log sheets will be organized by date and medium and filed in the project files. The field logbooks for this project will be used only for this site and will also be categorized and maintained in the project files after the completion of the field program. Project personnel completing concurrent field sampling activities may maintain multiple field logbooks. When possible, logbooks will be segregated by sampling activity. The field logbooks will be titled based on date and activity.

The data handling procedures to be followed by Katahdin, Microbac, and ALS, will meet the requirements of the technical specifications. Electronic data results will be automatically downloaded into the Tetra Tech database in accordance with the proprietary Tetra Tech processes.

The Tetra Tech PM (or designee) is responsible for the overall tracking and control of data generated for the project.

Data management will include the following:

• Data Tracking. Data are tracked from generation to archiving in the Tetra Tech project-specific files. The Tetra Tech Project Chemist (or designee) is responsible for tracking the samples collected and shipped to Katahdin, Microbac, and ALS. Upon receipt of the data packages

Revision: 1

Date: September 2014 Worksheet 29

Page 161 of 178

from Katahdin, Microbac, and ALS, the Tetra Tech Project Chemist will monitor the data validation effort, which includes verifying that the data

packages are complete and that results for all samples have been delivered by Katahdin, Microbac, and ALS.

• Data Storage, Archiving, and Retrieval. The data packages received from Katahdin, Microbac, and ALS will be tracked in the data

validation logbook. After the data are validated, the data packages will be entered into the Tetra Tech Navy CLEAN file system and archived

in secure files. The field records including field log books, sample log sheets, chain-of-custody records, and field calibration logs will be

submitted by the Tetra Tech FOL to be entered into the Navy CLEAN file system prior to archiving in secure project files. Project files are

audited for accuracy and completeness. As documents are finalized all relevant data is uploaded electronically to NIRIS and is retained there

indefinitely. Upon project completion paper copies go to the Federal Record Center for long term storage (50 years archival).

• Data Security. Access to Tetra Tech project files is restricted to designated personnel only. Records can only be borrowed temporarily from

the project file using a sign-out system. The Tetra Tech Data Manager maintains the electronic data files, and access to the data files is

restricted to qualified personnel only. File and data backup procedures are routinely performed.

• Electronic Data. All electronic data is validated and qualifiers are manually added to the database. The manually entered qualifiers are

verified by the DVM by direct QA, as well as an electronic verification step using proprietary Tetra Tech processes. Then data will be compiled

into a NIRIS Electronic Data Deliverable (NEDD) and loaded into NIRIS in accordance with Navy procedures. This process includes a QA

review of the data to ensure that the content and format of the data satisfy the requirements of NIRIS uploads. The NEDD is submitted

through a data checker into NIRIS which also ensures the format is acceptable.

• Data Reporting. Data will be generated by the laboratory in a CLP-like format. Upon completion of data validation, Tetra Tech will convert

relevant data into the MEDEP EDD format and submit the EDDs to MEDEP.

Date: September 2014 Worksheet 30 Page 162 of 178

SAP Worksheet #30 -- Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Sample Location/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person and telephone number)	Backup Laboratory/ Organization (name and address, contact person and telephone number)
Surface Water and Aqueous QC samples	Perchlorate	See Worksheet #18	SW-846 6850	21 Calendar days	Microbac 158 Starlite Drive Marietta, Ohio 45750 Contact: Stephanie Mossburg Laboratory PM 800.373.4071 x 4149	NA
Soil, Sediment, hexavalent (hexavalent	Hexavalent chromium ORP reported as Eh	See Worksheet #18	SW-846 7199 ASTM D1498	21 Calendar days	Larry Lewis Larry.Lewis@caslab.com ALS Rochester	NA
chromium, pH, and ORP) Surface Water and Aqueouis QC samples (hexavalent chromium)	рН		SW-846-9045C		1565 Jefferson Road, Building 300, Suite 360 Rochester, NY 14623 1 585 672 7469	
Soil, Sediment, Surface Water	TCL VOCs	See Worksheet	SW-846 5030, 8260B	21 Calendar days	Katahdin Analytical Services, Inc. 600 Technology Way	NA
and Aqueous	TAL Metals (total)	#18	SW-846 6020A, 7470A		Scarborough, Maine 04074	
QC samples	TCL SVOCs (including low-level PAHs and 1,4- dioxane)		SW-846 8270D/8270D SIM		Contact: Jennifer Obrin Laboratory PM 207.874.2400	
	TCL Pesticides and PCBs		SW-846 8081B/8082A]	20.10.112.100	
	Explosives plus NG		SW-846 8330B			
	VPH		MADEP-VPH-04-1.1			
	EPH		MADEP-EPH-04-1.1			

Katahdin will also perform IDW sample analysis.

> Date: September 2014 Worksheet 31 Page 163 of 178

SAP Worksheet #31 -- Planned Project Assessments Table

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of Corrective Action (title and organizational affiliation)
Laboratory Systems Audit ⁽¹⁾	Every 2 years	External	DoD ELAP Accrediting Body	DoD ELAP Accrediting Body Auditor	Laboratory QA Manager or Laboratory Manager, Katahdin, Microbac, and ALS	Laboratory QA Manager or Laboratory Manager, Katahdin, Microbac, and ALS	Laboratory QA Manager or Laboratory Manager, Katahdin, Microbac, and ALS

¹ Katahdin and ALS are DoD ELAP-accredited and Maine accredited for all respective analytical groups (as described above) and target analytes required for this project. Microbac is DoD ELAP-accredited for all respective analytical groups and target analytes required for this project. The DoD ELAP and Maine accreditation documentation is included in Appendix H.

Date: September 2014 Worksheet 32 Page 164 of 178

SAP Worksheet #32 -- Assessment Findings and Corrective Action Responses

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Time Frame of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Time Frame for Response
Laboratory Systems Audit	Written audit report	Leslie Diamond, Laboratory QA Manager, Katahdin Wade DeLong, Laboratory Technical Director, Microbac Marietta Lisa Reyes, Laboratory QA Manager, ALS	Specified by DoD ELAP Accrediting Body	Letter	DoD ELAP Accrediting Body	Specified by DoD ELAP Accrediting Body

Date: September 2014 Worksheet 33 Page 165 of 178

SAP Worksheet #33 -- QA Management Reports Table (UFP QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Data Validation Report	Per SDG	Within 3 weeks after receiving the data from the laboratory	Project Chemist or Data Validator, Tetra Tech	PM, Tetra Tech; project file
Major Analysis Problem Identification (Internal Memorandum)	When persistent analysis problems are detected	Immediately upon detection of problem – on the same day	QAM, Tetra Tech	PM, Tetra Tech; QAM, Tetra Tech; Program Manager, Tetra Tech; project file
Project Monthly Progress Report	Monthly for duration of the project	Monthly	PM, Tetra Tech	PM, Tetra Tech; QAM, Tetra Tech; Program Manager, Tetra Tech; Navy RPM; project file
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection of problem - on the same day	Laboratory PM, Katahdin, Microbac, and ALS	PM and project file, Tetra Tech

SAP Worksheet #34 -- Verification (Step I) Process Table (UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Chain-of-Custody Forms	The Tetra Tech FOL or designee will review and sign each chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and that the sample information is accurate. The forms will be signed by the sampler, and a copy will be retained for the project file, Tetra Tech PM, and Tetra Tech Data Validators.	Internal	Sampler and FOL, Tetra Tech
	 1 - The Laboratory Sample Custodian will review the sample shipment for completeness and integrity and will sign accepting the shipment. 2 - The Tetra Tech Data Validators will check that the chain-of-custody form was signed and dated by the Tetra Tech FOL or designee relinquishing the samples and also by the Laboratory Sample Custodian receiving the samples for analyses. 	External	1 - Laboratory Sample Custodian, Katahdin, Microbac, and ALS 2 - Data Validators, Tetra Tech
SAP Sample Tables/ Chain-of-Custody Forms	The Tetra Tech FOL or designee will review each chain-of-custody form to verify that all samples listed in the SAP have been collected. All deviations will be documented in the report.	Internal	FOL or designee, Tetra Tech
Sample Log Sheets	Verify that information recorded on the log sheets is accurate and complete.	Internal	FOL or designee, Tetra Tech
SAP/Field Logs/ Analytical Data Packages	Ensure that all sampling SOPs were followed. Verify that deviations have been documented and MPCs have been achieved. Particular attention should be given to verifying that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain of custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented.	Internal	PM or designee, Tetra Tech
SAP/Analytical SOPs/ Analytical Data Packages	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied.	Internal	Laboratory QAM, Katahdin, Microbac, and ALS

Date: September 2014 Worksheet 34 Page 167 of 178

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
SAP/Laboratory SOPs/ Raw Data/Applicable Control Limits Tables	Establish that all method QC samples were analyzed and in control, as listed in the analytical SOPs. If method QA is not in control, the Laboratory QAM will contact the Tetra Tech PM verbally or via e-mail for guidance prior to report preparation.	Internal	Laboratory QAM, Katahdin, Microbac, and ALS
SAP/Chain-of-Custody Forms	Check that field QC samples listed in Worksheet #20 were collected as required.	Internal	FOL or designee, Tetra Tech
Electronic Data Deliverables/Analytical Data Packages	Each EDD will be verified against the chain-of-custody form and hard copy data package for accuracy and completeness. Laboratory analytical results will be verified and compared to the electronic analytical results for accuracy. Sample results will be evaluated for laboratory contamination and will be qualified for false positives using the laboratory method/preparation blank summaries. Positive results reported between the DL and the LOQ will be qualified as estimated. Extraneous laboratory qualifiers will be removed from the list of validation qualifier.	External	Data Validators, Tetra Tech
Analytical Data Packages	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAM, Katahdin, Microbac, and ALS
	Each data package will be verified for completeness by the Tetra Tech Data Validator. Missing information will be requested by the Tetra Tech Data Validator from the Laboratory PM.	External	Data Validators, Tetra Tech

Verification includes field data verification and laboratory data verification. Verification inputs as per this worksheet will be checked.

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI Revision: 1 Date: September 2014 Worksheet 35 Page 168 of 178

SAP Worksheet #35 -- Validation (Steps IIa and IIb) Process Table (UFP-QAPP Manual Section 5.2.2) (Figure 37 UFP-QAPP Manual) (Table 9 UFP-QAPP Manual)

Step IIa/ IIb	Validation Input	Description	Responsible for Validation (name, organization)
lla	SA/Sample Log Sheets	Ensure that sample locations are correct and in accordance with the SAP proposed locations. Document any discrepancies in the final report.	PM, FOL, or designee, Tetra Tech
lla	Chain-of-Custody Forms	Ensure that the custody and integrity of the samples was maintained from collection to analysis and that the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperatures and that the sample pH values for chemically preserved samples met the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times listed in Worksheet #19.	Project Chemist or Data Validators, Tetra Tech
lla/llb	SAP/Laboratory Data Packages/ EDDs	Ensure that the laboratory QC samples listed in Worksheet #28 were analyzed and that the MPCs listed in Worksheet #12 were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Project Chemist or Data Validators, Tetra Tech
		Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or %D values from laboratory duplicate analyses, MS/MSDs, and LCS/LCSDs, if available. Ensure compliance with the methods and project MPCs accuracy goals listed in Worksheet #12.	
		Check that the laboratory recorded temperatures at sample receipt and pH of chemically preserved samples to ensure sample integrity from sample collection to analysis.	
		Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Tetra Tech Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted and the missing information will be requested. Validation will be performed as per Worksheet #36. Check that all data have been transferred correctly and completely to the final SQL database.	

CTO 69 031303/P

Date: September 2014 Worksheet 35 Page 169 of 178

Step IIa/ IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIb	SAP/Laboratory Data Packages/ EDDs	Ensure that the project LOQs listed in Worksheet #15 were achieved. Discuss the impact on reported DLs of matrix interferences or sample dilutions, performed because of the high concentration of one or more other contaminants, on the other target compounds reported as non-detected. Document this usability issue	Project Chemist or Data Validators, , risk assessors, and PM, Tetra Tech
		and inform the Tetra Tech PM. Review and add PSLs to the laboratory EDDs. Flag samples and notify the Tetra Tech PM of samples that exceed PSLs listed in Worksheet #15.	
		Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the Tetra Tech PM.	
		Summarize deviations from methods, procedures, or contracts in the Data Validation Report. Determine the effect of any deviation from sampling or analytical methods and SOP requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of the project database data depicting data qualifiers and data qualifier codes that summarize the reasons for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	

Page 170 of 178

SAP Worksheet #36 -- Analytical Data Validation (Steps IIa and IIb) Summary Table (UFP-QAPP Manual Section 5.2.2.1)

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
Ila and IIb	Soil, Sediment, Surface Water, and Aqueous QC Samples	VOCs, SVOCs including low- level PAHs and 1,4-dioxane, VPH, and EPH	Tier II ⁽¹⁾ data validation. Project-specific criteria for VOCs by SW-846 8260B, SVOCs by SW-846 8270D, low-level PAHs by SW-846 8270D SIM, VPH by MADEP-VPH-04-1.1, and EPH by MADEP-EPH-04-1.1 are listed in Worksheet #s 12, 15, 24, and 28. Region I USEPA-Northeast (NE) Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part II, December 1996 (USEPA, 1996) will be applied using these criteria.	
IIa and IIb	Soil, Sediment, Surface Water, and Aqueous QC Samples	Explosives plus NG, Pesticides, and PCBs	Tier II ⁽¹⁾ data validation. Criteria for ethylene dibromide by SW-846 8011 are listed in Worksheet #s 12, 15, 19, 24, and 28. Region I USEPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part III, February 2004 (USEPA, 2004) will be applied using these criteria.	
IIa and IIb	Soil, Sediment, Surface Water, and Aqueous QC Samples	Metals	Tier II ⁽¹⁾ data validation. Project-specific criteria for metals by SW-846 6010C/6020A/7470A/7471B are listed in Worksheet #s 12, 15, 19, 24, and 28. Region I USEPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, November 2008 (USEPA, 2008) will be applied using these criteria.	
lla and llb	Surface water and Aqueous QC Samples	Perchlorate	Tier II ⁽¹⁾ data validation. Project-specific criteria for perchlorate by SW-846 6850 are listed in Worksheets #12, #15, #19, #24, and #28.	
IIa and IIb	Soil, Sediment, Surface Water, and Aqueous QC Samples	Hexavalent Chromium	Tier II ⁽¹⁾ data validation. Project-specific criteria for metals by SW-846 7199 are listed in Worksheet #s 12, 15, 19, 24, and 28. Region I USEPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part IV, November 2008 (USEPA, 2008) will be applied using these criteria.	

^{1.} As defined in the Region I USEPA-NE Data Validation Functional Guidelines for Evaluating Environmental Analyses, Part I, Attachment B, Region 1 Tiered Organic and Inorganic Data Validation Guidelines, July 1, 1993, Draft (USEPA, 1996b).

Date: September 2014 Worksheet 37 Page 171 of 178

SAP Worksheet #37 -- Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Data Usability Assessment

The usability of the data generated during the RI directly affects whether project objectives can be achieved. The following characteristics will be evaluated at a minimum, and the results of these evaluations will be included in the project report. The characteristics will be evaluated for multiple concentration levels if the evaluator determines that this is necessary. To the extent required by the type of data being reviewed, the evaluator will consult with other technically competent individuals to render sound technical assessments of these DQI characteristics:

Completeness

For each matrix scheduled to be sampled, the Tetra Tech FOL, acting on behalf of the Project Team, will prepare a table listing to compare planned samples/analyses to collected samples/analyses. If deviations from the scheduled sample collection or analyses are identified, the Tetra Tech PM will determine whether the deviations compromise the ability to meet project objectives. If they do, the Tetra Tech PM will consult with the Navy RPM and other Project Team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

Precision

The Tetra Tech Project Chemist, acting on behalf of the Project Team, will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheet #s 12 and 28. This will also include a comparison of field and laboratory precision with the expectation that laboratory duplicate results will be no less precise than field duplicate results. If the goals are not met, or if data have been flagged as estimated (J qualifier), limitations on the use of the data will be described in the project report.

Accuracy

The Tetra Tech Project Chemist, acting on behalf of the Project Team, will determine whether the accuracy/bias goals were met for project data. This will be accomplished by comparing %Rs of LCSs, LCSDs, MSs, MSDs, and surrogate compounds to accuracy goals identified in Worksheet #28. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, MSs, and LCSs. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on overall project data will also be described in the project report.

Representativeness

A Tetra Tech Project Scientist, identified by the Tetra Tech PM and acting on behalf of the Project Team, will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and processed for analysis in accordance with the SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the Project Scientist indicates that a quantitative analysis is required.

Comparability

The Tetra Tech Project Chemist, acting on behalf of the Project Team, will determine whether the data generated under this project are sufficiently comparable to historical site data generated by different methods and for samples collected using different procedures and under different site

Date: September 2014 Worksheet 37 Page 172 of 178

conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the Tetra Tech Project Chemist indicates that such quantitative analysis is required.

Sensitivity

The Tetra Tech Project Chemist, acting on behalf of the Project Team, will determine whether project sensitivity goals listed in Worksheet #15 were achieved. The overall sensitivity and LOQs from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described in the project report. The Tetra Tech Project Chemist may enlist the help of the Project Risk Assessor to evaluate deviations from planned sensitivity goals.

Project Assumptions and Data Outliers

The data usability assessment is performed at the conclusion of data collection activities using the outputs from data verification and data validation. The data interpretation phase involves a qualitative and quantitative evaluation of environmental data to determine if the project data are of the type, quality, and quantity to support the decisions that need to be made. It involves a retrospective evaluation of the systematic planning process, and like the systematic planning process, involves participation by key members of the Project Team. The data usability assessment evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

After the completion of data validation, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these DQI characteristics. The statistical evaluations will include simple summary statistics for target analytes, such as maximum concentrations, minimum concentrations, numbers of samples with non-detected results, number of samples with detected results, and the proportions of samples with detected and non-detected results. The Project Team members, identified by the Tetra Tech PM, will assess whether the data collectively support the attainment of project objectives. The Project Team will consider whether any missing or rejected data have compromised the ability to make decisions or to make decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated for by other data. Although rejected data will generally not be used, there may be reason to use them in a weight-of-evidence argument, especially when they supplement data that have not been rejected. If rejected data are used, their use will be supported by technically defensible rationales.

Duplicate results (original and duplicate) will not be averaged for the purpose of representing ranges of concentrations and depicting tag maps. For the positive detection tables, the original result, the duplicate result, and the average will be shown. The average of original and duplicate sample concentrations will be used to represent the concentration at a particular sampled location during risk assessment.

> Date: September 2014 Worksheet 37 Page 173 of 178

Identify the personnel responsible for performing the usability assessment:

The Tetra Tech PM, Project Chemist, FOL, and Project Scientist/Risk Assessor will be responsible for conducting the listed data usability assessments. The data usability assessment will be reviewed with the Navy RPM, MEDEP RPM, and USEPA RPM. If deficiencies affecting the attainment of project objectives are identified, the review will take place either in a face-to-face meeting or teleconference, depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). Written documentation will support the non-compliance estimated or rejected data results. The project report will identify and describe the data usability limitations and suggest resampling or other CAs, if necessary.

Revision: 1

Date: September 2014 References

Page 174 of 178

REFERENCES

Buchman, M. F., 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle,

WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration, 34

pages. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

CCME (Canadian Council and Ministers of the Environment), 1999. Canadian soil quality guidelines for

the protection of environmental and human health. (Separate documents for each chemical).

Dean KE, Palachek RM, Noel JM, et al. 2004. Development of freshwater water-quality criteria for

perchlorate. Environ Toxicol Chem 23(6):1441-1451.

DoD (Department of Defense), 2007. DoD Perchlorate Handbook. Revision 1 Change 1. August.

DoD, 2010. Department of Defense Quality Systems Manual for Environmental Laboratories. Version

4.2.October.

Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997a. Toxicological Benchmarks for Contaminants of

Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision.

Oak Ridge National Laboratory. November. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997b. Toxicological Benchmarks for

Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge

National Laboratory. November. ES/ER/TM-85/R3.

Gannet Fleming, 2003. The Field Investigation of Bedrock in the Explosive Ordinance Disposal Range

Brunswick Naval Air Station. January.

IDQTF (Interagency Data Quality Task Force), 2005. Uniform Federal Policy for Quality Assurance

Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use

Programs, Parts 1, 2A, 2B, and 2C. Final, Version 1. March.

Jones, D.S., R.N. Hull, and G.W. Suter II, 1997. Toxicological Benchmarks for Screening Contaminants

of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision. Risk Assessment

Program, Health Sciences Division, Oak Ridge, Tennessee. ES/ER/TM-95/R4. November.

Revision: 1

Date: September 2014 References Page 175 of 178

LANL (Los Alamos National Laboratory), 2012. ECORISK Database (Release 3.1). LA-UR-12-24548.

ER ID 107524. Environmental Programs Directorate, Los Alamos National Laboratory, Los Alamos, New

Mexico. October.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-

Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental

Contamination and Toxicology, Vol. 39, pp. 20-31.

Malcolm Pirnie, Inc., 2006. Final Preliminary Assessment Naval Air Station Brunswick, Maine. February.

N60087.AR001545 NAS Brunswick 5090.3a.

Malcolm Pirnie, 2007. Preliminary Assessment Addendum, Naval Air Station Brunswick, Maine. July.

Maine Geological Survey, 2013. Maine Geological Survey Water Well Shapefile, February. Downloaded

September 4,. www.maine.gove/doc/nrimc/mgs/pubs/digital/well.htm

MEDEP, (Maine Department of Environmental Protection) 2012. Surface Water Quality Criteria for Toxic

Pollutants. Chapter 584. Effective July 13, 2012.

MEDEP, 2014. Remediation Guidelines for Petroleum Contamination Sites in Maine. MEDEP Bureau of

Remediation & Waste Management. May.

MHSPE (Ministry of Housing, Spatial Planning and Environment), 2000. Circular on target values and

intervention values for soil remediation. Ministry of Housing, Spatial Planning and

Environment. DBO/1999226863. Department of Soil Protection, The Netherlands. February 4.

OSHA (Occupational Safety and Health Administration) General Industry Standards, Chapter 29, Code of

Federal Regulations 1910.120.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of

Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy. August.

SERDP (Strategic Environmental Research and Development Program), 2012. Development of Toxicity

Benchmarks and Bioaccumulation Data for N-Based Organic Explosives for Terrestrial Plants and Soil

Invertebrates, ER-1416, November,

Revision: 1

Date: September 2014

References Page 176 of 178

Sunahara, G.I., G.R. Lotufo, R.G Kuperman, and J. Hawari. 2009. Ecotoxicology of Explosives. CRC

Press, Taylor and Francis Group.

Tetra Tech, 2009. Site Inspection Report for Munitions and Explosives of Concern Areas Site 12 EOD

Area, Former Munitions Bunker West Area, Quarry. Naval Air Station Brunswick, June.

Tetra Tech, 2012a. Background Study Report for Naval Air Station Brunswick, March.

Tetra Tech, 2012b. Bedrock Fracture Trace Analysis Report, Quarry Area and Site 12 EOD Area.

Former Naval Air Station Brunswick. August 2.

Tetra Tech, 2012c Work Plan Groundwater Investigation, Quarry Area, Former Naval Air Station

Brunswick, Maine, August 6.

Tetra Tech 2012d. Draft Technical Memorandum Groundwater Report, Quarry Area, Former Naval Air

Station Brunswick (in review). November.

Tetra Tech, 2013. Draft Munition and Explosive of Concern Investigation Report. Quarry Area, Naval Air

Station Brunswick. January (in Navy review).

Tetra Tech, 2014. Technical Memorandum Groundwater Report, Quarry Area. Former Naval Air Station

Brunswick. March (in Navy review).

USEPA (United States Environmental Protection Agency), 1996a. ECO Update, Ecotox Thresholds. U.S.

Environmental Protection Agency. Office of Solid Waste and Emergency Response. Intermittent Bulletin,

Volume 3, Number 2. EPA540/F-95/038. January.

USEPA 1996b, Region I USEPA-NE Data Validation Functional Guidelines for Evaluating Environmental

Analyses, Part II, December 1996.

USEPA, 1999. Contract Laboratory Program National Functional Guidelines for Organics Data Review.

EPA540/R-99/008. Office of Emergency and Remedial Response, Washington, DC. October.

USEPA, 2002. Guidance for Quality Assurance Project Plans (EPA QA/G-5). EPA/240/R-02/009.

USEPA Office of Environmental Information, Washington DC. December.

Revision: 1

Date: September 2014 References

Page 177 of 178

USEPA, 2003a. Resource Conservation and Recovery Act Corrective Action Ecological Screening

Levels, USEPA Region 5 (http://www.epa.gov/reg5rcra/ca/ edql.htm). August.

USEPA, 2003b. Guidance for Developing Ecological Soil Screening Levels, Office of Solid Waste and

Emergency Response, Directive 9285.7-55. November.

USEPA, 2003c. Recommendations of the Technical Review Workgroup for Lead for an Approach to

Assessing Risks Associated with Adult Exposures to Lead in Soil. USEPA. Washington, DC. EPA-540-R-

03-001. [URL: http://www.epa.gov/superfund/ programs/lead/adult.htm].

USEPA 2004, Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental

Analyses, Part III, February 2004.

USEPA, 2005a. Ecological Soil Screening Level for Barium, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-63. February.

USEPA, 2005b. Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP), Evaluating,

Assessing, and Documenting Environmental Data Collection and Use Programs (Final Version 1), EPA-

505-B-04-900A. March.

USEPA, 2005c. Ecological Soil Screening Level for Arsenic, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-62. March.

USEPA, 2005d. Ecological Soil Screening Level for Cadmium, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-65. March.

USEPA, 2005e. Ecological Soil Screening Level for Cobalt, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-67. March.

USEPA, 2005f. Ecological Soil Screening Level for Lead, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-70. March.

USEPA, 2006a. Region 3 Freshwater Sediment Screening Benchmarks. August.

http://www.epa.gov/reg3hwmd/risk/eco/index.htm

Former NAS Brunswick Quarry Area UFP-SAP for Soil/Sediment/Surface Water RI

Revision: 1

Date: September 2014

References Page 178 of 178

USEPA, 2006b. Region 3 Freshwater Surface Water Screening Benchmarks. July.

http://www.epa.gov/reg3hwmd/risk/eco/index.htm

USEPA, 2006c. Guidance on Systematic Planning using the Data Quality Objectives Process. EPA

QA/G-4, EPA/240/B-06/001. Office of Environmental Information, Washington DC. February.

USEPA, 2006d. Ecological Soil Screening Level for Silver, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-77. October.

USEPA, 2007. Guidance for Developing Ecological Soil Screening Levels. Office of Solid Waste and

Emergency and Response. http://www.epa.gov/ecotox/ecossl/. (separate document for each chemical).

USEPA, 2008. Ecological Soil Screening Level for Chromium, Interim Final. Office of Emergency and

Remedial Response. OSWER Directive 9285.7-66. April.

USEPA, 2008b. Test Methods for Evaluating Solid Waste; Physical/Chemical Methods (SW-846), 3rd

Edition, up to and Including Update IV. Office of Solid Waste and Emergency Response, Washington,

DC. February.

USEPA, 2008. Region I EPA-NE Data Validation Functional Guidelines for Evaluating Environmental

Analyses, Part IV, November.

USEPA, 2009. Interim Drinking Water Health Advisory for Perchlorate, EPA-822-R-08-25. January.

USEPA, 2010. Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows version

(IEUBKwin v 1.1 Build 11).

USEPA, 2013. National Recommended Water Quality Criteria: 2013. Office of Water.

http://water.epq.gov/scitech/swguidance/standards/criteria/current/index.cfm.

USEPA, 2014. Regional Screening Levels for Chemical Contaminants at Superfund Sites. RSL Table

Update.http://epa-prgs.ornl.gov/chemicals/index.shtml. May.

031303/P **CTO 69**

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 1 OF 8

		Lassian	L	ithology		Analyt	ical		Partia mala	
Area ⁽¹⁾	Matrix Area ⁽¹⁾	Location Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	Rationale for Lithology and Sample Locations	Analytical Rationale
		1			0-1, only if waste disposal evident	TBD in field only if waste disposal evident				Soil samples to be collected only if evidence of waste disposal is present, therefore, Locations 2 and 5 (within borrow area of 1958 map) should be
DU1		2	Natural	Excavator	0-1, only if waste disposal evident	TBD in field only if waste disposal evident		Explosives & NG	Extent of quarrying operations and characteristics of waste/material used for backfill are currently unknown and will be determined by investigation inside and outside of the borrow pit quarried area shown on the 1958 map (the 1958).	investigated before Locations 1, 3, and 4. If waste disposal evident, all proposed soil samples will be collected and analyzed for the full suite of analytes due to the varied history and unknown disposal
Quarried Backfill Area North of Radar Tower Access	Soil	3	material		0-1, only if waste disposal evident	TBD in field only if waste disposal evident	0 to 10	VOCs SVOCs EPH/VPH Pesticides PCBs	quarry boundary is unlikely to represent the end date of quarrying operations Also, depth to bedrock information is necessary to refine understanding of th site geology (Location 5).	If soil sample collection is warranted (i.e., physical evidence of waste disposal present), confirm
Road		4	Bedrock,		0-1, only if waste disposal evident	aste posal waste disposal evident			Locations are along proposed MEC RI transect lines to coordinate findings and facilitate access.	absence of MC as anticipated based on absence of MEC concluded from MEC TCRA findings. If soil sample collection is warranted (i.e., physical
		5	anticipated 27' bgs DPT R Natural Excepted	DPT Rig	0-1, only if waste disposal evident	TBD in field only if waste disposal evident				evidence of waste disposal present), determine presence/absence of non-munitions-related/fuel constituents.
		6	Natural material	Excavator					Site geology is variable considering the unknown extent of quarrying operations. Although 13 existing monitoring well borings largely allow	
		7	Bedrock, anticipated 30-35' bgs	DPT Rig	0-1			Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs	geology/hydrogeology evaluation, refinement is warranted. The waste disposal boundary and characteristics of waste/material used for backfill are currently unknown and will be determined by investigation inside and outside of the borrow pit quarried area shown on the 1958 map (the 1958 quarry boundary is unlikely to represent the end date of quarrying operations). Locations for lithology refinement of site geology will be collected by DPT Rig and extend to bedrock (Locations 7, 23, 25, 38, 47, and 51, and contingent Location 22 as warranted). Otherwise locations will extend to natural material is encountered or to the depth of sampling if natural material is shallow.	The selected soil samples will be analyzed for the full suite of analytes to due to the varied history and unknown disposal practices within the quarried area.
DU2/DU3/DU4a DUs Inside Quarry Fence	Soil	8	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #12 not successful			24		If MEC trench excavation is unable to extend to natural material, a contingent soil boring will be drilled nearby a given incomplete trench; see 12 contingent locations (8, 9, 10, 12, 14, 17, 18, 19, 22, 28, 29, and 41).	MC are of concern based on historical munitions operations. Fuel-related constituents are of concern based on
		9	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #16 not successful					Locations for determining nature and extent of contamination to include a minimum 11 in place (i.e., not mixed via disturbance with excavator) locations for risk assessment inside Quarry Fence: - Landfarming area, as per Preliminary Assessment, predominantly up to the first 3 feet in depth (5 locations: 21, 27, 37, 38, and 40) - Suspect munitions detonation area, (perceive be be between grids C-	historical landfarming operations. Confirm presence/absence of other chemical contaminant suites.
		10	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #15 not successful					6 and B-6 based on MEC TCRA findings) (3 locations: 43, 44, and 50) - Other areas for site coverage (3 locations: 7, 23, 25) Locations are along proposed MEC RI transect lines to coordinate findings and facilitate access, moreover, locations are biased toward areas of previously identified munitions items and non-munitions debris and for overall coverage of the area.	

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 2 OF 8

		<u> </u>								
(0)	Matrix	Location	L	ithology		Analy			Rationale	
Area ⁽¹⁾	Area ⁽¹⁾	Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	for Lithology and Sample Locations	Analytical Rationale
		11	Natural material	Excavator						
		12	Natural Material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #18 not successful						
		13	Natural material	Excavator						
		14	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #24 not successful						
		15	Natural material	Excavator						
		16	Natural material	Excavator						
DU2/DU3/DU4a DUs Inside Quarry Fence (continued)	Soil	17	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #13 not successful						
		18	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #17 not successful						
		19	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #19 not successful						
		20	Natural material	Excavator						
		21	Natural material	DPT Rig	0 - 1	 1-3 TBD in field if waste disposal evident, otherwise 2-foot interval above native material 		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 3 OF 8

		Landier	L	ithology		Analy	tical		Darlamata	
Area ⁽¹⁾	Matrix Area ⁽¹⁾	Location Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	Rationale for Lithology and Sample Locations	Analytical Rationale
		22	Bedrock anticipated 2-5' bgs	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #30 not successful						
		23	Bedrock, anticipated 30-35' bgs	DPT Rig	0-1			Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
		24	Natural material	Excavator						
		25	Bedrock, anticipated 20' bgs	DPT Rig	0-1			Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
DU2/DU3/DU4a		26	Natural material	Excavator						
DUs Inside Quarry Fence	Soil	27	Natural material	DPT Rig	0 - 1	 1-3 TBD in field if waste disposal evident, otherwise 2-foot interval above native material 		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
		28	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #26 not successful						
		29	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #31 not successful						
		30	Natural material	Excavator						
		31	Natural material	Excavator						
		32	Natural material	Excavator						

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 4 OF 8

			L	ithology		Analy	tical			
Area ⁽¹⁾	Matrix Area ⁽¹⁾	Location Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	Rationale for Lithology and Sample Locations	Analytical Rationale
		33	Natural material	Excavator						
		34	Natural material	Excavator						
		35	Natural material	Excavator						
		36	Natural material	Excavator						
		37	Natural material	DPT Rig	0 - 1	 TBD in field if waste disposal evident, otherwise 2-foot interval above native material 		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
DU2/DU3/DU4a		38	Bedrock, anticipated 4-5' bgs	DPT Rig	0 - 1	 TBD in field if waste disposal evident, otherwise 2-foot interval above native material 		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
DUs Inside Quarry Fence	Soil	39	Natural material	Excavator			-			
		40	Natural material	DPT Rig	0 - 1	 1-3 TBD in field if waste disposal evident, otherwise 2-foot interval above native material 		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
		41	Natural material	CONTINGENT REPLACEMENT ⁽³⁾ Install with DPT rig only if excavation at Trench #29 not successful						
		42	Natural material	Excavator						
		43	Natural material	Hand Auger Surface Soil Excavator Subsurface Soil	0 - 1	1-3		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 5 OF 8

	Motrix	Location	Li	thology		Analyt	ical		Rationale	
Area ⁽¹⁾	Matrix Area ⁽¹⁾	Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	for Lithology and Sample Locations	Analytical Rationale
		44	Natural material	Hand Auger Surface Soil Excavator Subsurface Soil	0 - 1	1-3		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
		45	Natural material	Excavator						
		46	Natural material	Excavator						
		47	Bedrock, anticipated 5' bgs	DPT Rig						
		48	Natural material	Excavator						
		49	Natural material	Excavator						
DU2/DU3/DU4a DUs Inside Quarry Fence	Soil	50	Natural material	Hand Auger Surface Soil Excavator Subsurface Soil	0 - 1	1-3		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs		
		51	Bedrock, anticipated 4-5' bgs	Drill Rig						
		52	Natural material	Excavator						
		MEC RI Trench locations with Tetra Tech logging of lithology	Natural material for all trenches except Trench #30 to bedrock	Excavator		TBD in field [up to 2 per each of 22 trenches]	22 - 44	Explosives & NG TAL Metals ⁵ If sample related to non-munitions (e.g., drum, staining), add: VOCs SVOCs EPH/VPH Pesticides PCBs	Locations are biased to previously identified high density geophysical anomalies where metallic items, including munitions items, are suspected, as well as biased high elevated contaminant concentrations, and supplement with the 11 historical trenches opportunity sampling associated with the MEC TCRA. Trench locations are both inside and outside the landfarming area. If excavation is unable to extend to natural material, a contingent soil boring will be drilled nearby: See 12 contingent locations (8, 9, 10, 12, 14, 17, 18, 19, 22, 28, 29, and 41). The locations for sampling will be based on field conditions, with focus on munitions items, drums or where field observations indicate staining or elevated PID readings. If more than 2 locations per trench are warranted, contingency samples will be employed. If no items are encountered except for metallic construction debris as the source of anomalies, 1 subsurface sample will be collected from excavated soil from the approximate center of the trench. TRENCHES WILL NOT BE BACKFILLED UNTIL TETRA TECH SAMPLING AND RECORDING OF LITHOLOGY ARE COMPLETE.	All soil samples will be analyzed for the full suite of analytes due to the varied history and unknown disposal practices within the quarried area. MC are of concern based on historical munitions operations. Fuel-related constituents are of concern based on historical landfarming operations. Confirm presence/absence of other chemical contaminant suites.

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 6 OF 8

	Madain	Location	Li	thology		Analyt	tical		Detionals	
Area ⁽¹⁾	Matrix Area ⁽¹⁾	Location Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	Rationale for Lithology and Sample Locations	Analytical Rationale
		53	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵		
		54	1 ft bgs	Hand Auger	0 - 1		1	Explosives & NG TAL Metals ⁵		
		55	Bedrock, anticipated 4' bgs	DPT Rig	0 - 1			Explosives & NG TAL Metals ⁵		
		56	3 ft bgs	Hand Auger	0 - 1	1 - 3		Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs	Depth to bedrock information is necessary to refine the site geology (Location 55).	Because the historical activity in this area does not appear to be as complex as within the fence, all soil samples will be analyzed for MC analytes only,
DU4b Kickout Area (East of Quarry Fence, north of	Soil	57	3 ft bgs	Hand Auger	0 - 1	1 - 3	15	Explosives & NG TAL Metals ⁵ VOCs SVOCs EPH/VPH Pesticides PCBs	Determine nature and extent of potential contamination associated with suspected historical munitions detonation operations kickouts and/or training. Based on MEC findings, munitions items were located on the ground surface or just below the ground surface; therefore, only surface soil has the potential to be contaminated, except at drum locations (56 and 57) where migration of contaminants to subsoils is possible. Should evidence of subsurface	except for soil borings associated with drums or where field observations indicate staining or elevated PID readings, in which case a full suite of analysis may be requested. MC are of concern based on historical munitions operations.
Old Route 24)		58	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵	contamination be encountered, contingency samples will be employed.	Fuel-related constituents or other chemical
		59	1 ft bgs	Hand Auger	0 - 1		-	Explosives & NG TAL Metals ⁵	Locations are along proposed MEC RI transect lines to coordinate findings and facilitate access, moreover, locations are biased toward areas of previously identified munitions items and non-munitions debris and drums, and for overall	contaminant suites are of concern if a historical release from drums occurred.
		60	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵	coverage of the area.	
		61	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵		
		62	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵		
		63	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵		
		64	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵		
		65	1 ft bgs	Hand Auger	0 - 1			Explosives & NG TAL Metals ⁵		
		66	1 ft bgs	Hand Auger						
DU4b Kickout Area (South of	Soil	67	Bedrock, anticipated 5-10' bgs	DPT Rig	0 – 1		5	Explosives & NG TAL Metals ⁵	Because the historical activity in this area does not appear to be as complex as within the fence, all soil samples will be analyzed for MC analytes only based	Because the historical activity in this area does not appear to be as complex as within the fence, all soil samples will be analyzed for MC analytes only
Quarry Fence, south of Old		68	1 ft bgs	Hand Auger				I AL IVIETAIS	on historical munitions operations.	MC are of concern based on historical munitions
Route 24)		69	1 ft bgs	Hand Auger						operations.
		70	1 ft bgs	Hand Auger						

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 7 OF 8

			Li	thology		Analy	tical			
Area ⁽¹⁾	Matrix Area ⁽¹⁾	Location Number	Termination Depth	Methodology	Surface Soil (feet bgs)	Subsurface Soil (feet bgs)	Total Number Samples ⁽²⁾	Analysis	Rationale for Lithology and Sample Locations	Analytical Rationale
Contingency (4)	Soil	Not Applicable		TBD in field	0 – 1	TBD	0 to 12	Explosives & NG TAL Metals ⁵ If contingency sample related to non-munitions (e.g., drum, staining), add: VOCs SVOCs EPH/VPH Pesticides PCBs	Contingency samples will be collected as necessary based on field observations of indications of contamination such as presence of MEC, drum, or visual (soil staining) and/or olfactory (elevated PID readings) observations. Contingency samples may be collected as an additional sample in an existing boring location over a 2-foot interval or within a MEC RI transect line or trench intrusive investigation.	MC are of concern based on historical operations site wide and should be included for all contingency samples. For non-munitions related samples associated with drums or where field observations indicate staining or elevated PID readings, in which case a full suite of analysis may be requested.
DU5 Seasonal Drainage Areas	Sediment	1 2 3 4 5 6 7 8	To 1 ft bgs	Hand Auger	0 – 0.5	0.5 - 1	18	Explosives & NG TAL Metals ⁵ SVOCs EPH/VPH Pesticides PCBs VOCs ONLY at sediment locations 3, 5, and 7	Sediment samples will be collected from 3 distinct seasonal drainage areas, located near the staff gauges, that may have varying nature and extent of contamination; at the base of the rock wall (1, 2, 3 and 4), at the culvert west of the Quarry Area (5), and beyond the culvert for stormwater runoff south of Old Route 24 (Significant Vernal Pool #42, 6, 7, 8, and 9). The significant vernal pool #42 is of particular ecological concern. Moreover, migration of groundwater to surface water is a pathway of concern during seasonal conditions of high water levels.	MC (explosives, NG, and metals) are of concern based on historical operations. Migration of site contaminants via erosion and overland flow to ponded areas results in sediment serving as a potential collection point for any site contaminants. Therefore, sediment samples will all be analyzed for all site contaminants of potential concern, including MC (explosives, NG, and metals) based on historical munitions operations, fuel-related constituents based on historical landfarming operations, and other chemical contaminant suites based on unknown sources. VOCs are not typically an ecological suite of concern and so only 1 VOC sample per drainage area is warranted.
	Surface Water	3 5 8	NA	Direct Dip or Weighted Bottle	NA	NA	3	Explosives, perchlorate, & NG TAL Metals ⁵ SVOCs EPH/VPH Pesticides PCBs VOCs	Surface water samples will be collected from 3 distinct seasonal drainage areas, located near the staff gauges, that may have varying nature and extent of contamination; at the base of the rock wall (collocated with sediment sample location 3), at the culvert west of the Quarry Area (collocated with sediment sample location 5), and beyond the culvert for stormwater runoff south of Old Route 24 (Significant Vernal Pool #42, collocated with sediment sample location 8). The significant vernal pool #42 is of particular ecological concern. Moreover, migration of groundwater to surface water is a pathway of concern during seasonal conditions of high water levels. Surface water samples will be collected before the ponds are drained during the MEC investigation and sediment samples will be collected after the ponds are drained.	MC (explosives, NG, and metals) are of concern based on historical operations. Migration of site contaminants via erosion and overland flow to ponded areas results in surface water serving as a potential collection point for any site contaminants. Therefore, surface water samples will all be analyzed for all site contaminants of potential concern, including MC (explosives, NG, and metals) based on historical munitions operations, fuel-related constituents based on historical landfarming operations, and other chemical contaminant suites based on unknown sources.

^{1.} Sampling approach proposed relies on focusing data collection activities in several areas with various site conceptual model differences. Lateral and vertical boundaries for DU1 through DU5 are not yet established. While some DUs overlap laterally, vertically these overlapping DUs can be differentiated based on the current-day conceptual site model. Specifically, DU3 Landfarming Area and DU4b Kickout Area are vertically situated above DU2 Quarried Backfill Area Inside Quarry Fence:

DU1 Quarried Backfill Area north of Radar Tower Access Road DU2 Quarried Backfill Area Inside Quarry Fence

DU3 Landfarming Area

DU4a Detonation Area

DU4b Kickout Area

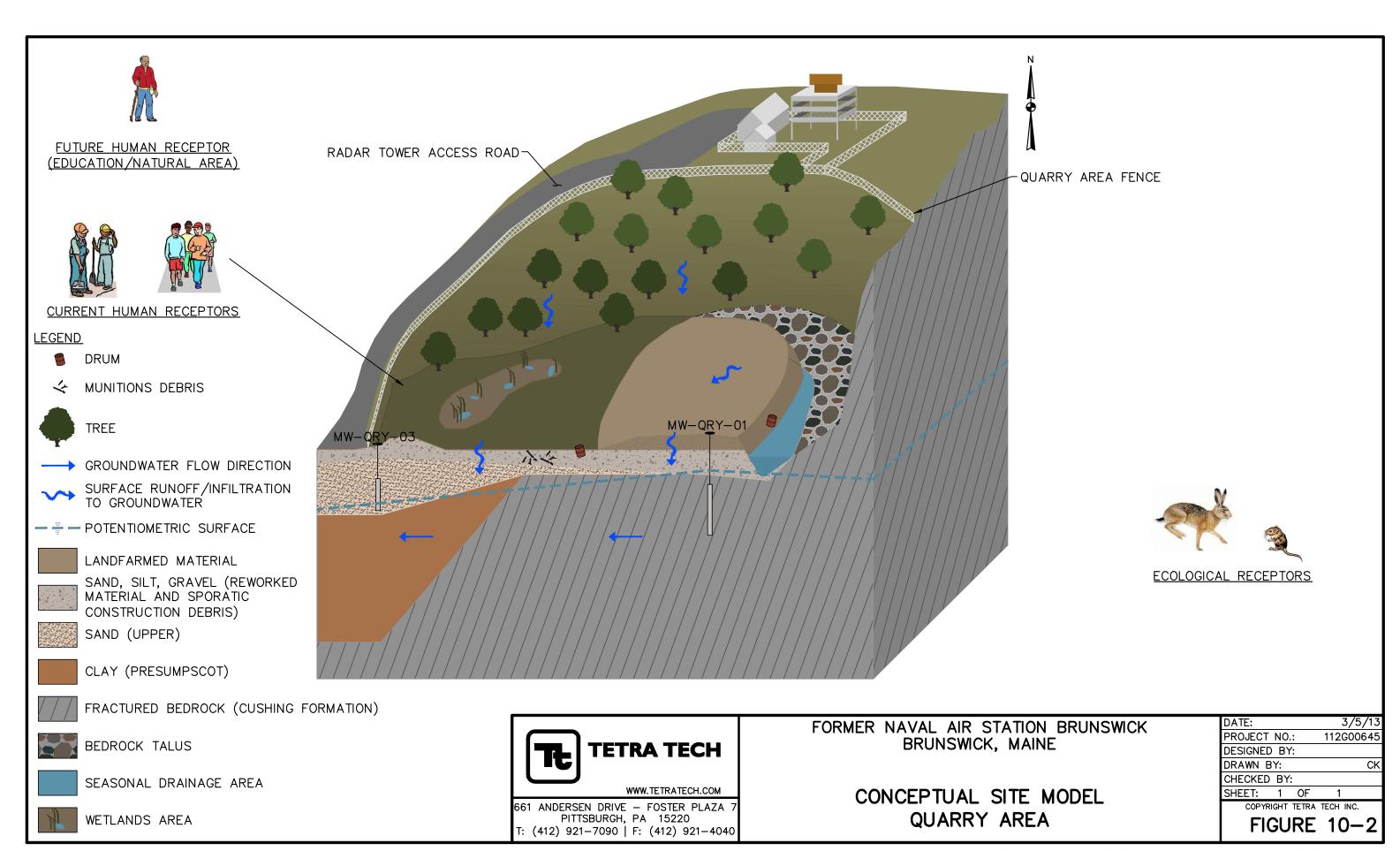
DU5 Seasonal Drainage Areas

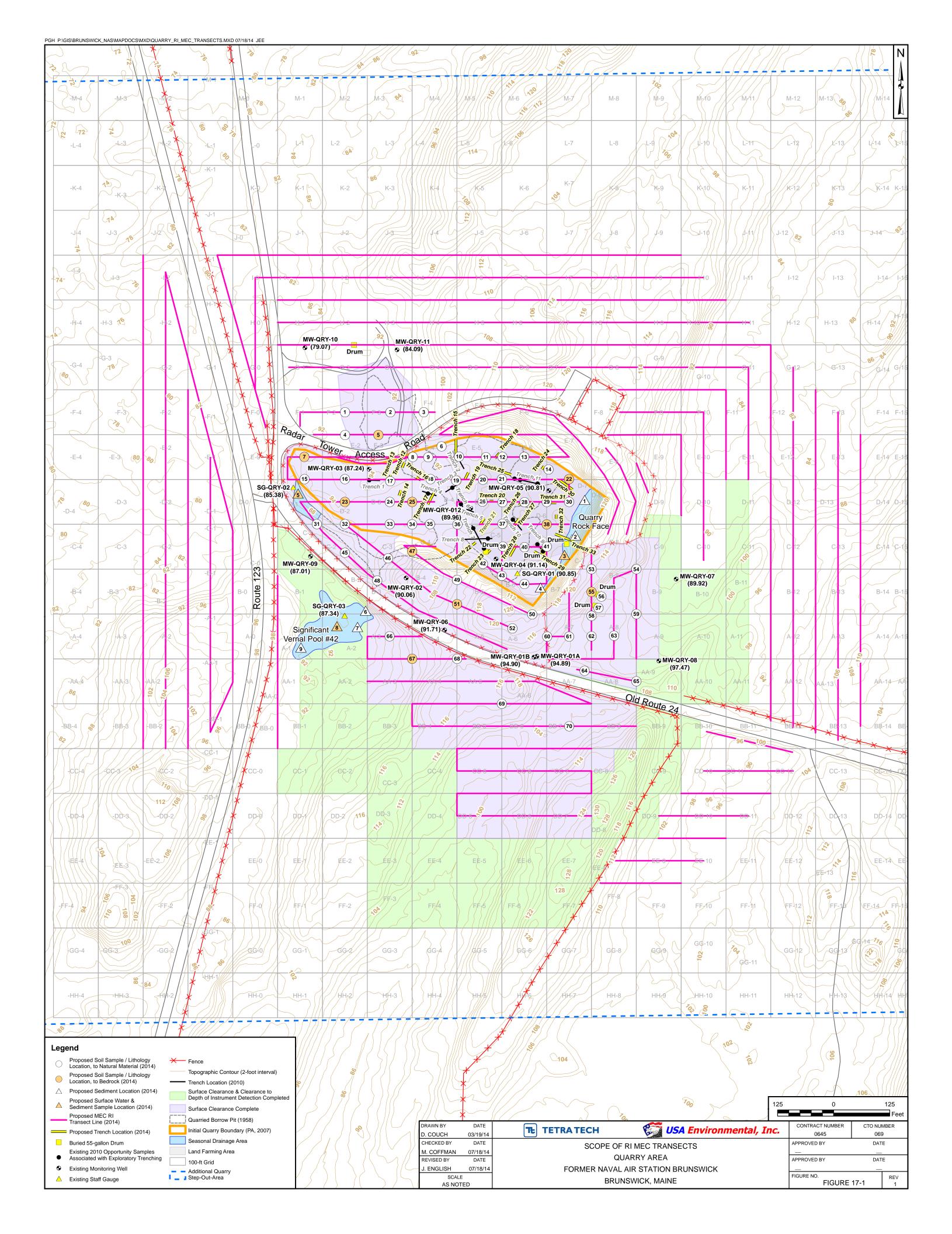
DU6 Groundwater (addressed in separate previous investigation)

SOIL/SEDIMENT/SURFACE WATER SAMPLING STRATEGY QUARRY AREA, FORMER NAS BRUNSWICK, MAINE PAGE 8 OF 8

- 2. All samples will be discrete. No composite or incremental samples are planned.
 3. Contingent Replacement samples not included in analytical totals because these locations will only be sampled if MEC RI Trench samples can not be collected, the Contingent Replacement sample analysis would be the same as MEC RI Trench sample analysis.
- Contingency samples will be collected only if warranted (e.g., staining, elevated PID readings, munitions items, drums).

 Ten percent of the soil and sediment samples collected for TAL metals analysis will also be analyzed for hexavalent chromium, pH, and ORP will be continged for the surface water samples collected for TAL metals analysis will also be analyzed for hexavalent chromium (pH and ORP will be continged for the surface water samples collected for TAL metals analysis will also be analyzed for hexavalent chromium (pH and ORP will be continued for the surface water samples collected for TAL metals analysis will also be analyzed for hexavalent chromium. be measured in the field).





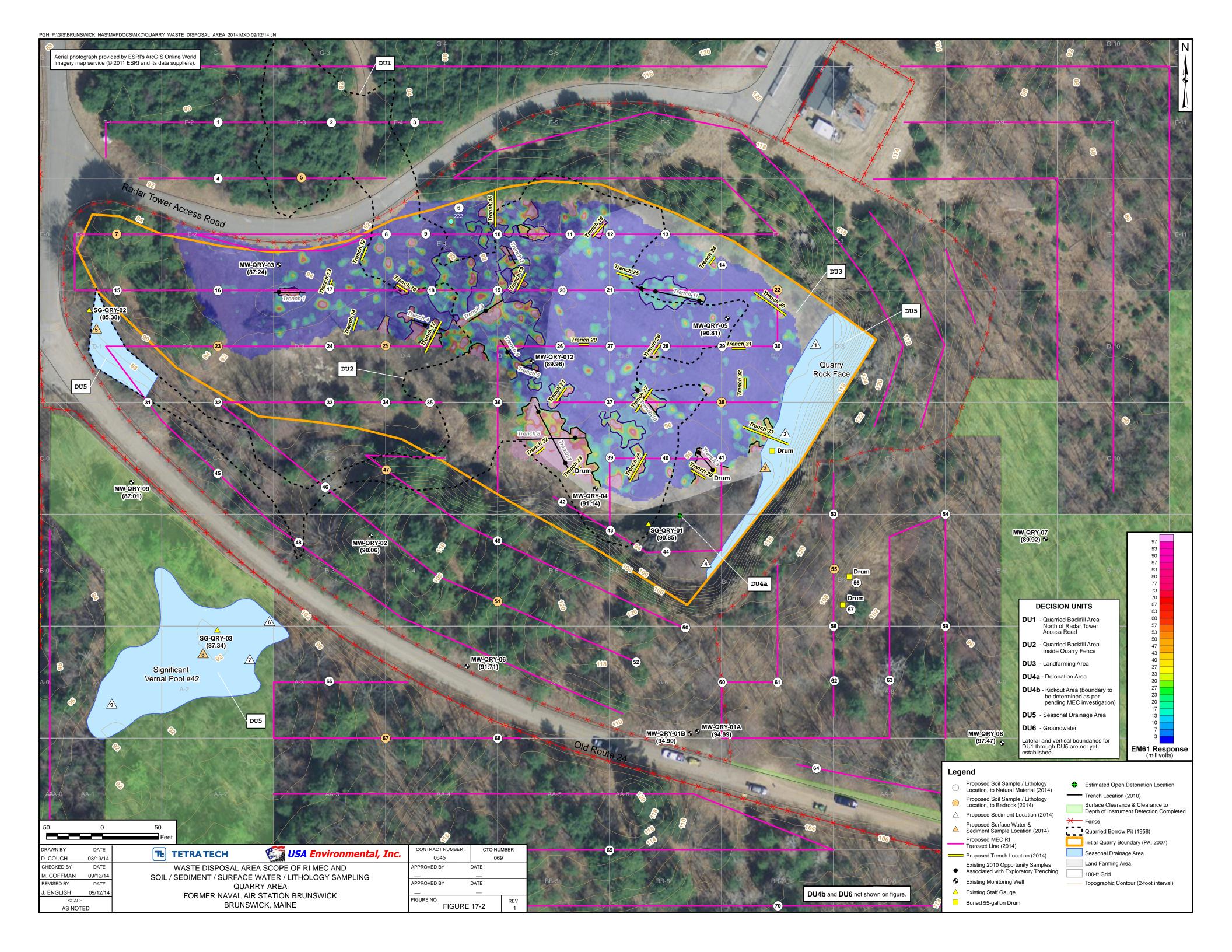


Figure 17-3A Sample Collection and Path Forward Decision Tree for DU1 Quarry Area, Former NAS Brunswick, Maine

DU1 - QUARRIED BACKFILL AREA NORTH OF RADAR TOWER ACCESS ROAD

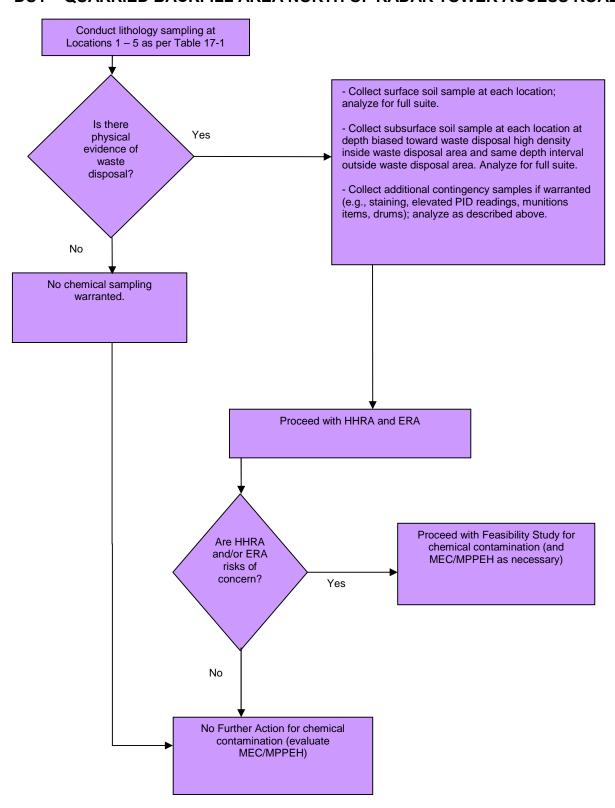


Figure 17-3B
Sample Collection and Path Forward Decision Tree for DU2, DU3, and DU4a
Quarry Area, Former NAS Brunswick, Maine

DU2 – QUARRIED BACKFILL AREA INSIDE QUARRY FENCE DU3 – LANDFARMING AREA DU4a – DETONATION AREA

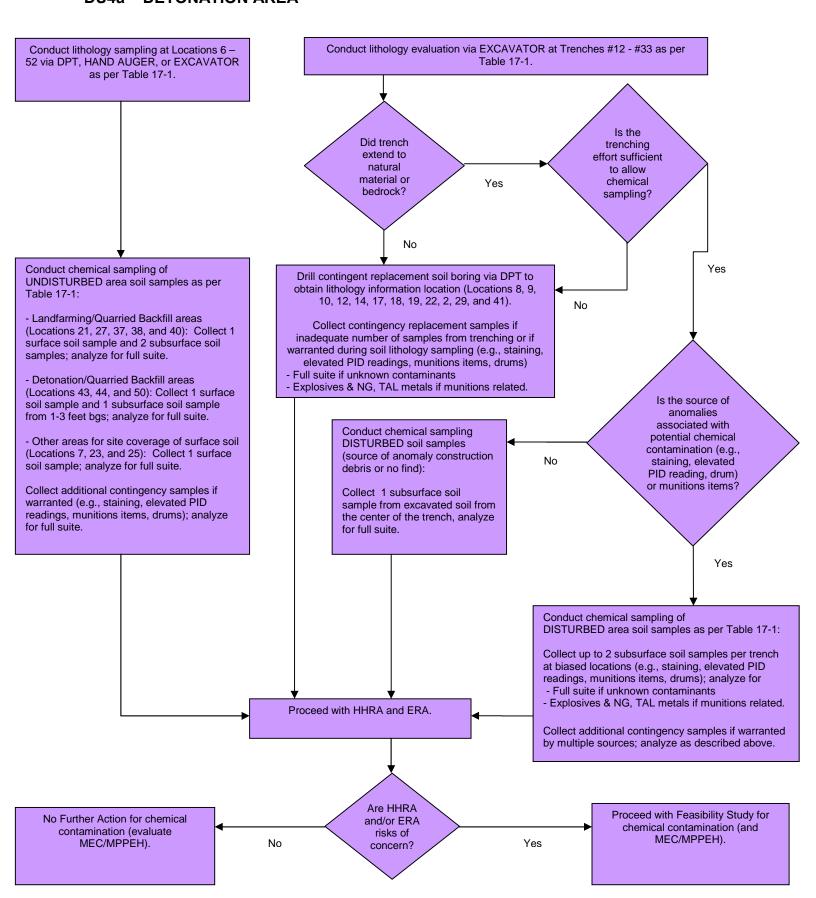
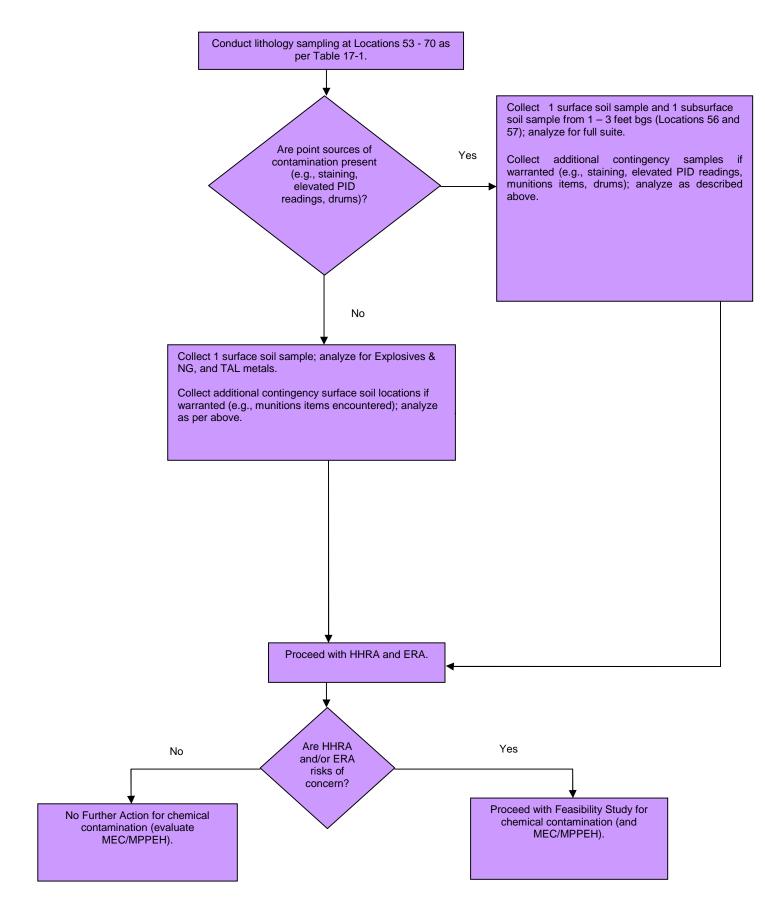
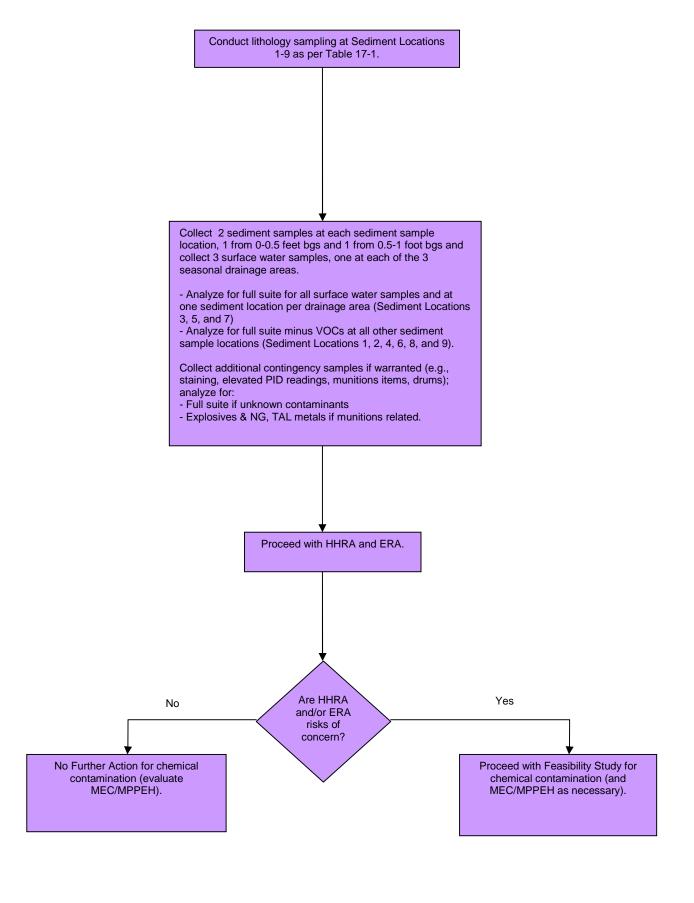


Figure 17-3C Sample Collection and Path Forward for DU4b Quarry Area, NAS Brunswick, Maine

DU4b - KICKOUT AREA

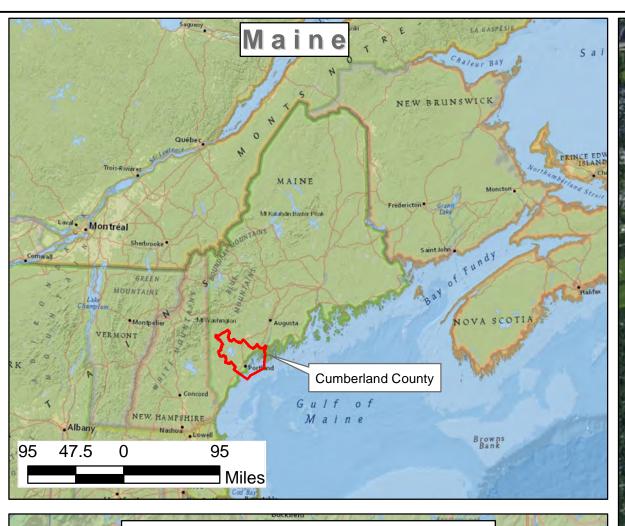


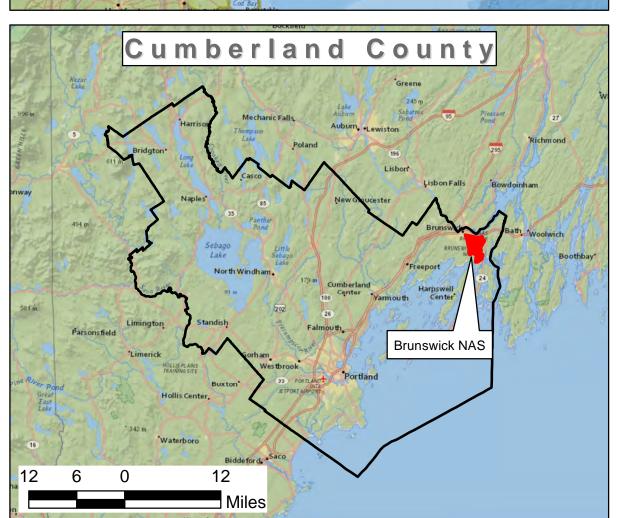
DU5 – SEASONAL DRAINAGE AREAS

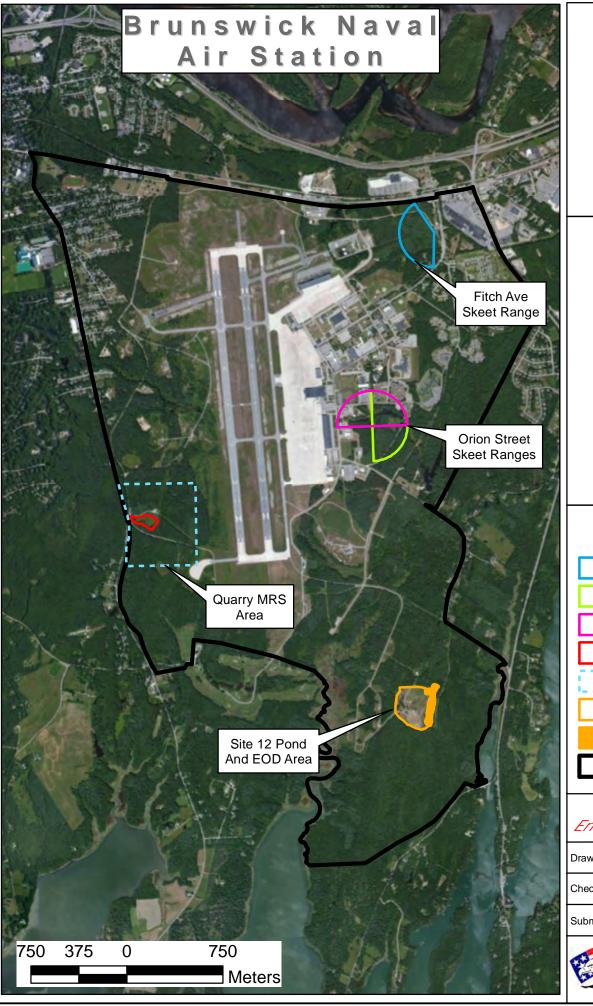


APPENDIX A

MEC SAP FIGURES (USA ENVIRONMENTAL)









Scale Varies

Data is projected to the UTM Coordinate System: Zone 19 North, NAD83, Units in Meters.

NAS Brunswick, Maine

Figure 1

NAS Brunswick Site Location Map

Legend

Fitch Ave Skeet Range

Orion Street Skeet Range - post-1950

Orion Street Skeet Range - pre-1950

Quarry Boundary

Quarry MRS Area

Site 12 EOD Area

Site 12 Pond

Brunswick NAS Boundary

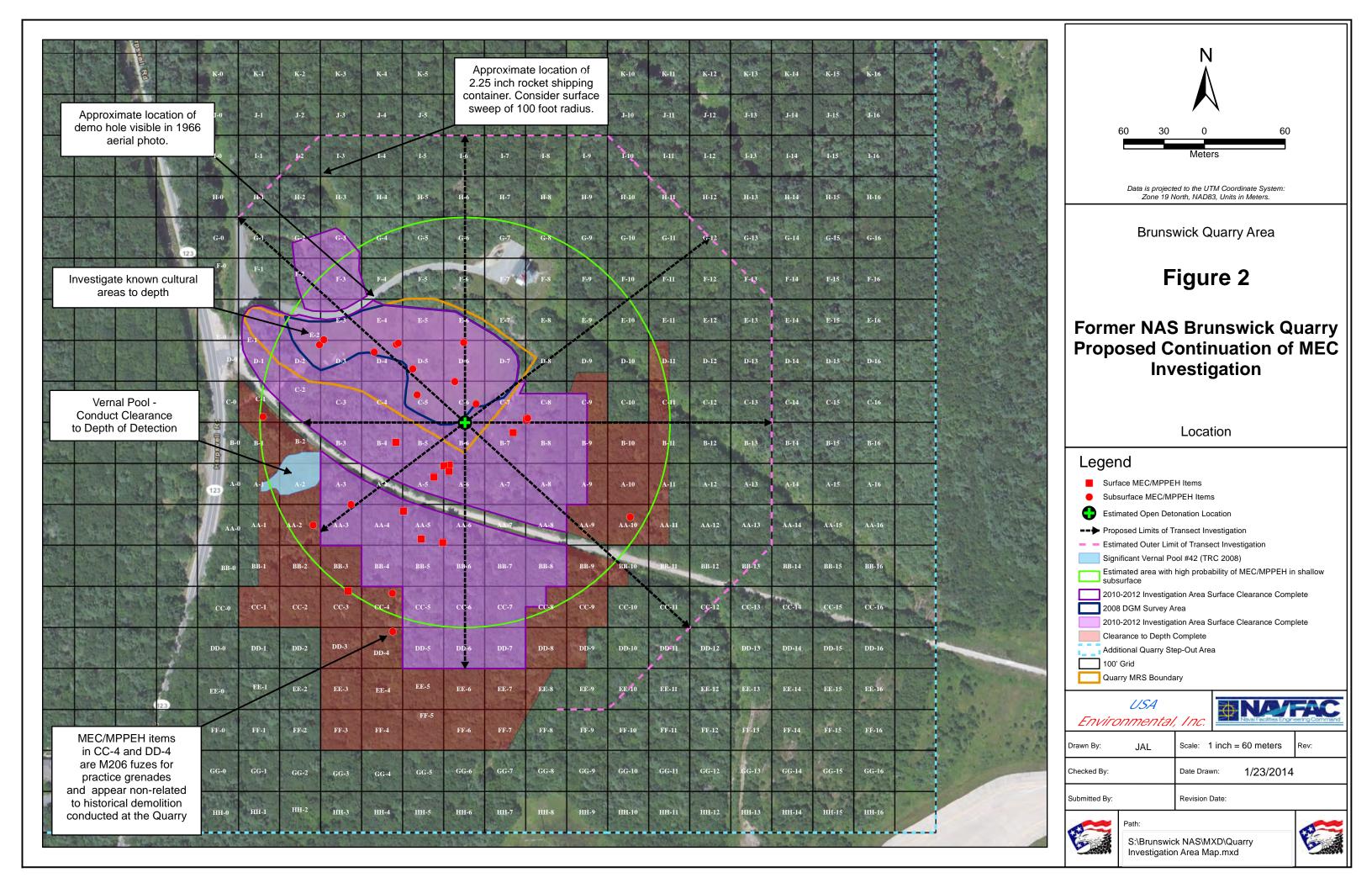
USA Environmental, Inc.

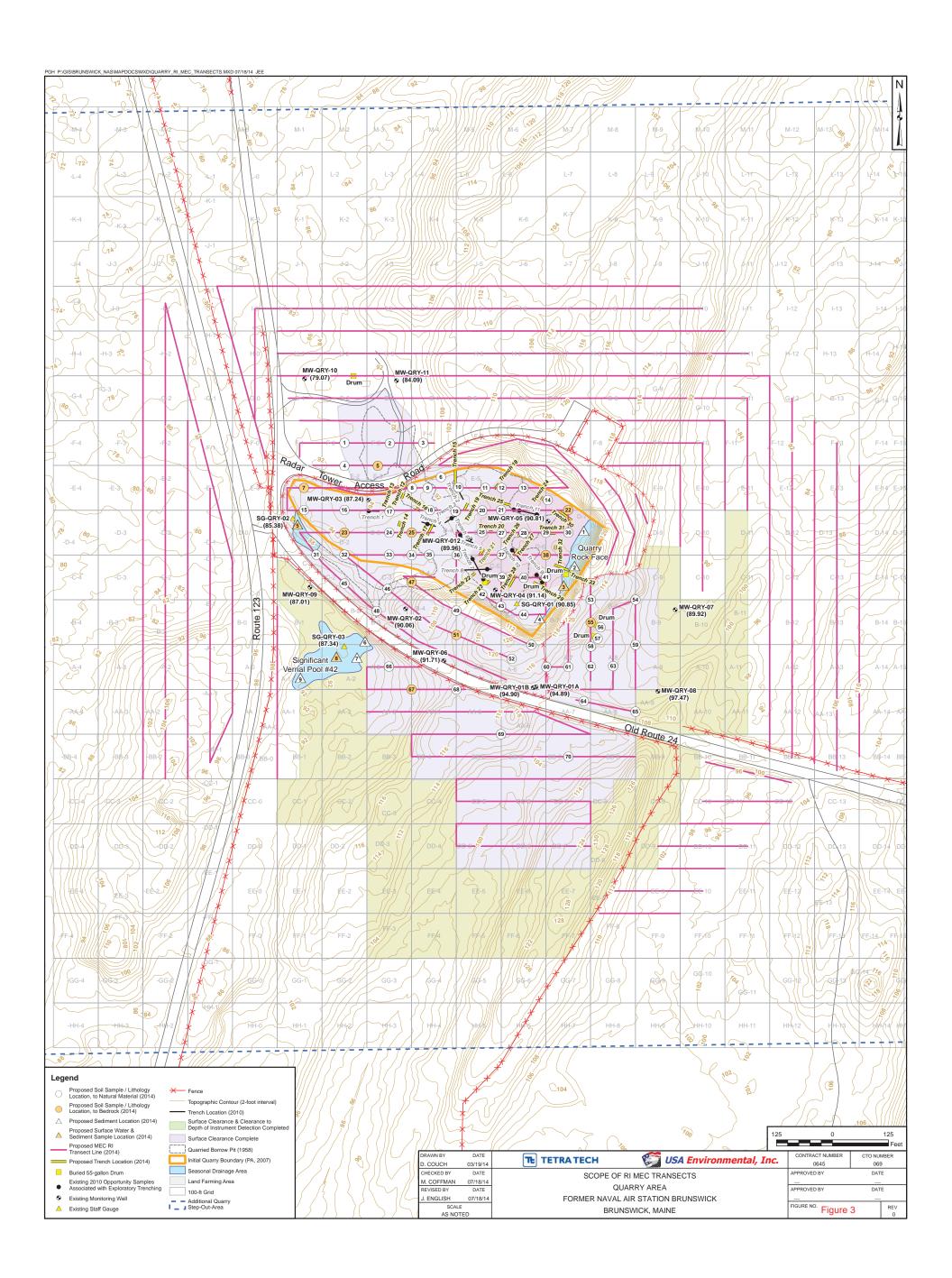


JAL Scale: Varies Checked By: Date Drawn: 10-26-2012 RHSubmitted By: Revision Date: 4/8/2014

S:\Brunswick NAS\MXD\Work Plan\Fig1_NAS Brunswick Site Location Map.mxd







APPENDIX B

PROJECT SCREENING-LEVEL SUPPORT DOCUMENTATION

HUMAN HEALTH SOIL SCREENING VALUES

Chemical	CAS#	EPA Residential Soil Direct Contact - Nov. 2013 (mg/kg)	Basis	Adjusted EPA Residential Soil Direct Contact - Nov. 2013 (mg/kg)	EPA Residential Soil Direct Contact - May 2014 (mg/kg)	Basis	Adjusted EPA Residential Soil Direct Contact - May 2014 (mg/kg)	PAL Reference
TAL Metals	7400 00 5	77000		7700	77000		7700	ED 4 DOI
ALUMINUM ANTIMONY	7429-90-5 7440-36-0	77000 31	n n	7700 3.1	77000 31	n n	7700 3.1	EPA RSL EPA RSL
ARSENIC	7440-38-2	0.61	C	0.61	0.67	C	0.67	EPA RSL
BARIUM	7440-39-3	15000	n	1500	15000	n	1500	EPA RSL
BERYLLIUM	7440-41-7	160	n	16	160	n	16	EPA RSL
CADMIUM	7440-43-9	70	n	7	70	n	7	EPA RSL
CALCIUM	7440-70-2	NC		NC	NC		NC	EPA RSL
CHROMIUM ⁽¹⁾	7440-47-3	0.29	С	0.29	0.30	С	0.30	EPA RSL
COBALT COPPER	7440-48-4	23	n	2.3	23	n	2.3	EPA RSL
IRON	7440-50-8 7439-89-6	3100 55000	n n	310 5500	3100 55000	n n	310 5500	EPA RSL EPA RSL
LEAD	7439-92-1	400	-"-	400	400	-"-	400	EPA RSL
MERCURY	7439-97-6	10	n	1	9.4	n	0.94	EPA RSL
MAGNESIUM	7439-95-4	NC		NC	NC		NC	EPA RSL
MANGANESE	7439-96-5	1800	n	180	1800	n	180	EPA RSL
NICKEL	7440-02-0	1500	n	150	1500	n	150	EPA RSL
POTASSIUM	7440-09-7	NC		NC NC	NC NC		NC	EPA RSL
SELENIUM SILVER	7782-49-2 7440-22-4	390 390	n	39 39	390 390	n n	39 39	EPA RSL EPA RSL
SODIUM	7440-22-4	NC	n 	NC	NC		NC	EPA RSL
THALLIUM	7440-28-0	0.78	n	0.078	0.78	n	0.078	EPA RSL
VANADIUM ⁽²⁾	7440-62-2	390	n	39	390	n	39	EPA RSL
ZINC	7440-66-6	23000	n	2300	23000	n	2300	EPA RSL
TCL VOCs								
1,1- DICHLOROETHANE	75-34-3	3.3	С	3.3	3.6	С	3.6	EPA RSL
1,1,1-TRICHLOROETHANE	71-55-6	8700	n	870	8100	n	810	EPA RSL
1,1,2- TRICHLOROETHANE	79-00-5	1.6	n	0.16	1.5	n	0.15	EPA RSL
1,1,2,2- TETRACHLORETHANE	79-34-5	0.56	С	0.56	0.60	С	0.60	EPA RSL
1,1,2-TRICHLORO-1,2,2-TRIFLUORO-ETHANE	76-13-1	43000	n	4300	40000	n	4000 23	EPA RSL
1,1-DICHLOROETHENE 1,2- DICHLOROBENZENE	75-35-4 95-50-1	240 1900	n n	24 190	230 1800	n n	180	EPA RSL EPA RSL
1,2- DICHLOROETHANE	107-06-2	0.43	C	0.43	0.46	C	0.46	EPA RSL
1,2,3-TRICHLOROBENZENE	87-61-6	49	n	4.9	49	n	4.9	EPA RSL
1,2,4-TRICHLOROBENZENE	120-82-1	62	n	6.2	58	n	5.8	EPA RSL
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.0054	С	0.0054	0.0053	С	0.0053	EPA RSL
1,2-DIBROMOETHANE	106-93-4	0.034	С	0.034	0.036	С	0.036	EPA RSL
1,2-DICHLOROPROPANE	78-87-5	0.94	С	0.94	1.0	С	1.0	EPA RSL
1,3-DICHLOROBENZENE	541-73-1	NC	С	NC	NC		NC	EPA RSL
1,4-DICHLOROBENZENE	106-46-7	2.4	С	2.4	2.6	С	2.6	EPA RSL
1,4-DIOXANE	123-91-1 78-93-3	4.9	C	4.9 2800	5.3 27000	C	5.3 2700	EPA RSL
2-BUTANONE 2-HEXANONE	591-78-6	28000 210	n n	21	200	n n	20	EPA RSL EPA RSL
4-METHYL-2-PENTANONE	108-10-1	5300	n	530	5300	n	530	EPA RSL
ACETONE	67-64-1	61000	n	6100	61000	n	6100	EPA RSL
BENZENE	71-43-2	1.1	С	1.1	1.2	С	1.2	EPA RSL
BROMOCHLOROMETHANE	74-97-5	160	n	16	150	n	15	EPA RSL
BROMODICHLOROMETHANE	75-27-4	0.27	С	0.27	0.29	С	0.29	EPA RSL
BROMOFORM	75-25-2	62	С	62	67	С	67	EPA RSL
BROMOMETHANE	74-83-9 75-15-0	7.3	n	0.73	6.8 770	n	0.68 77	EPA RSL
CARBON DISULFIDE CARBON TETRACHLORIDE	56-23-5	820 0.61	n c	82 0.61	0.65	n c	0.65	EPA RSL EPA RSL
CHLOROBENZENE	108-90-7	290	n	29	280	n	28	EPA RSL
CHLOROETHANE	75-00-3	15000	n	1500	14000	n	1400	EPA RSL
CHLOROFORM	67-66-3	0.29	С	0.29	0.32	С	0.32	EPA RSL
CHLOROMETHANE	74-87-3	120	n	12	110	n	11	EPA RSL
CIS-1,2-DICHLOROETHENE	156-59-2	160	n	16	160	n	16	EPA RSL
CIS-1,3-DICHLOROPROPENE ⁽³⁾	5	1.7	С	1.7	1.8	С	1.8	EPA RSL
CYCLOHEXANE	110-82-7	7000	n	700	6500	n	650	EPA RSL
DIBROMOCHLOROMETHANE	124-48-1 75-71-8	0.68 94	C	0.68 9.4	0.73 87	C	0.73 8.7	EPA RSL EPA RSL
DICHLORODIFLUOROMETHANE ETHYLBENZENE	100-41-4	5.4	n c	9.4 5.4	5.8	n c	8.7 5.8	EPA RSL EPA RSL
ISOPROPYLBENZENE	98-82-8	2100	n	210	1900	n	190	EPA RSL
METHYL ACETATE	79-20-9	78000	n	7800	78000	n	7800	EPA RSL
METHYL TERT-BUTYL ETHER	1634-04-4	43	С	43	47	С	47	EPA RSL
METHYLCYCLOHEXANE	108-87-2	NC		NC	NC		NC	EPA RSL
METHYLENE CHLORIDE	75-09-2	360	n	36	350	n	35	EPA RSL
STYRENE	100-42-5	6300	n	630	6000	n	600	EPA RSL
TETRACHLOROETHENE	127-18-4	86	n	8.6	81	n	8.1	EPA RSL
TOLUENE O-XYLENE	108-88-3 95-47-6	5000 690	n n	500 69	4900 650	n n	490 65	EPA RSL EPA RSL
m.p-XYLENE	108-38-3	590	n n	69 59	550	n n	55	EPA RSL EPA RSL
TOTAL XYLENES	1330-20-7	630	n	63	580	n	58	EPA RSL
TRANS-1,2-DICHLOROETHENE	156-60-5	150	n	15	1600	n	160	EPA RSL
TRANS-1,3-DICHLOROPROPENE ⁽³⁾	6	1.7	С	1.7	1.8	С	1.8	EPA RSL
TRICHLOROETHENE	79-01-6	4.4	n	0.44	4.1	n	0.41	EPA RSL
TRICHLOROFLUOROMETHANE	75-69-4	790	n	79	730	n	73	EPA RSL
VINYL CHLORIDE	75-01-4	0.06	С	0.06	0.059	С	0.059	EPA RSL
TCL SVOCs		T	, ,			, ,		
1,1'-BIPHENYL	92-52-4	51	n	5.1	47	n	4.7	EPA RSL
1,2,4,5-TETRACHLOROBENZENE 2,2-OXYBIS(1-CHLOROPROPANE)	95-94-3 108-60-1	18 4.6	n c	1.8 4.6	18 4.9	n	1.8 4.9	EPA RSL EPA RSL
2,3,4,6-TETRACHLOROPHENOL	108-60-1 58-90-2	1800	n	4.6 180	1800	c n	4.9 180	EPA RSL EPA RSL
2,4,5-TRICHLOROPHENOL	95-95-4	6100	n	610	6200	n	620	EPA RSL
2,4,6-TRICHLOROPHENOL	88-06-2	61	n	6.1	62	n	6.2	EPA RSL
2,4-DICHLOROPHENOL	120-83-2	180	n	18	180	n	18	EPA RSL
2,4-DIMETHYLPHENOL	105-67-9	1200	n	120	1200	n	120	EPA RSL
2,4-DINITROPHENOL	51-28-5	120	n	12	120	n	12	EPA RSL
2,4-DINITROTOLUENE	121-14-2	1.6	С	1.6	1.7	С	1.7	EPA RSL
2,6-DINITROTOLUENE	606-20-2	0.33	С	0.33	0.36	С	0.36	EPA RSL
2-CHLORONAPHTHALENE	91-58-7	6300	n	630	6300	n	630	EPA RSL

HUMAN HEALTH SOIL SCREENING VALUES

Chemical	CAS#	EPA Residential Soil Direct Contact - Nov. 2013 (mg/kg)	Basis	Adjusted EPA Residential Soil Direct Contact - Nov. 2013 (mg/kg)	EPA Residential Soil Direct Contact - May 2014 (mg/kg)	Basis	Adjusted EPA Residential Soil Direct Contact - May 2014 (mg/kg)	PAL Reference
2-CHLOROPHENOL	95-57-8	390	n	39	390	n	39	EPA RSL
2-METHYLNAPHTHALENE	91-57-6	230	n	23	230	n	23	EPA RSL
2-METHYLPHENOL	95-48-7	3100	n	310	3100	n	310	EPA RSL
2-NITROANILINE 2-NITROPHENOL	88-74-4 88-75-5	610 NC	n 	61 NC	610 NC	n 	61 NC	EPA RSL EPA RSL
3,3'-DICHLOROBENZIDINE	91-94-1	1.1	C	1.1	1.2	C	1.2	EPA RSL
3-NITROANILINE ⁽⁴⁾	99-09-2	24	С	24	250	n	25	EPA RSL
4,6-DINITRO-2-METHYLPHENOL	534-52-1	4.9	n	0.49	4.9	n	0.49	EPA RSL
4-BROMOPHENYL-PHENYLETHER	101-55-3	NC		NC	NC		NC	EPA RSL
4-CHLORO-3-METHYLPHENOL	59-50-7	6100	n	610	6200	n	620	EPA RSL
4-CHLOROANILINE	106-47-8	2.4	С	2.4	2.7	С	2.7	EPA RSL
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NC		NC	NC		NC	EPA RSL
4-METHYLPHENOL 4-NITROANILINE	106-44-5 100-01-6	6100	n	610	6200	n	620	EPA RSL
4-NITROPHENOL	100-01-6	24 NC	C	24 NC	250 NC	n 	25 NC	EPA RSL EPA RSL
ACENAPHTHENE	83-32-9	3400	n	340	3500	n	350	EPA RSL
ACENAPHTHYLENE ⁽⁵⁾	208-96-8	3400	n	340	3500	n	350	EPA RSL
ANTHRACENE	120-12-7	17000	n	1700	17000	n	1700	EPA RSL
ATRAZINE	1912-24-9	2.1	С	2.1	2.3	С	2.3	EPA RSL
BENZALDEHYDE	100-52-7	7800	n	780	7800	n	780	EPA RSL
BENZO(A)ANTHRACENE	56-55-3	0.15	С	0.15	0.15	С	0.15	EPA RSL
BENZO(A)PYRENE	50-32-8	0.015	С	0.015	0.015	С	0.015	EPA RSL
BENZO(B)FLUOROANTHENE	205-99-2	0.15	С	0.15	0.15	С	0.15	EPA RSL
BENZO(G,H,I)PERYLENE ⁽⁶⁾	191-24-2	1700	n	170	1700	n	170	EPA RSL
BENZO(K)FLUOROANTHENE	207-08-9	1.5	С	1.5	1.5	С	1.5	EPA RSL
BIS(2-CHLOROETHOXY) METHANE	111-91-1	180	n	18	180	n	18	EPA RSL
BIS-(2-CHLOROETHYL) ETHER	111-44-4	0.21	С	0.21	0.23	С	0.23	EPA RSL
BIS(2-ETHYLHEXYL) PHTHALATE BUTYLBENZYLPHTHALATE	117-81-7 85-68-7	35 260	C C	35 260	38 280	С	38 280	EPA RSL EPA RSL
CAPROLACTAM	105-60-2	30000	n c	3000	31000	c n	280 3100	EPA RSL
CARBAZOLE	86-74-8	NC	n 	NC	NC	n 	NC	EPA RSL
CHRYSENE	218-01-9	15	С	15	15	C	15	EPA RSL
DIBENZO(A,H)ANTHRACENE	53-70-3	0.015	С	0.015	0.015	С	0.015	EPA RSL
DIBENZOFURAN	132-64-9	78	n	7.8	72	n	7.2	EPA RSL
DIETHYLPHTHALATE	84-66-2	49000	n	4900	49000	n	4900	EPA RSL
DIMETHYLPHTHALATE	131-11-3	NC		NC	NC		NC	EPA RSL
DI-N-BUTYLPHTHALATE	84-74-2	6100	n	610	6200	n	620	EPA RSL
DI-N-OCTYLPHTHALATE	117-84-0	610	n	61	620	n	62	EPA RSL
FLUORANTHENE	206-44-0	2300	n	230	2300	n	230	EPA RSL
FLUORENE	86-73-7	2300	n	230	2300	n	230	EPA RSL
HEXACHLOROBENZENE HEXACHLOROBUTADIENE	118-74-1 87-68-3	0.3 61	c n	0.3 6.1	0.33 62	c n	0.33 6.2	EPA RSL EPA RSL
HEXACHLOROCYCLOPENTADIENE	77-47-4	370	n	37	370	n	37	EPA RSL
HEXACHLOROETHANE	67-72-1	43	n	4.3	43	n	4.3	EPA RSL
INDENO (1,2,3-CD)-PYRENE	193-39-5	0.15	C	0.15	0.15	С	0.15	EPA RSL
ISOPHORONE	78-59-1	510	С	510	560	С	560	EPA RSL
NAPHTHALENE	91-20-3	3.6	С	3.6	3.8	С	3.8	EPA RSL
NITROBENZENE	98-95-3	4.8	С	4.8	5.1	С	5.1	EPA RSL
N-NITROSO DIPHENYLAMINE	86-30-6	99	С	99	110	С	110	EPA RSL
N-NITROSO-DI-N PROPYLAMINE	621-64-7	0.069	С	0.069	0.076	С	0.076	EPA RSL
PENTACHLOROPHENOL	87-86-5	0.89	С	0.89	0.99	С	0.99	EPA RSL
PHENANTHRENE ⁽⁶⁾	85-01-8	1700	n	170	1700	n	170	EPA RSL
PHENOL PYRENE	108-95-2 129-00-0	18000 1700	n n	1800 170	18000 1700	n n	1800 170	EPA RSL EPA RSL
TCL Pesticides	129-00-0	1700	п	170	1700	n	170	EPARSL
4,4'-DDD	72-54-8	2	С	2	2.2	С	2.2	EPA RSL
4,4'-DDE	72-55-9	1.4	С	1.4	1.6	С	1.6	EPA RSL
4,4'-DDT	50-29-3	1.7	С	1.7	1.9	С	1.9	EPA RSL
ALDRIN	309-00-2	0.029	С	0.029	0.031	С	0.031	EPA RSL
ALPHA-BHC	319-84-6	0.077	С	0.077	0.085	С	0.085	EPA RSL
ALPHA-CHLORDANE ⁽⁷⁾	5103-71-9	1.6	С	1.6	1.8	С	1.8	EPA RSL
BETA-BHC	319-85-7	0.27	С	0.27	0.30	С	0.30	EPA RSL
DELTA-BHC	319-86-8	NC 0.02		NC 0.00	NC 0.000		NC 0.000	EPA RSL
DIELDRIN	60-57-1	0.03	С	0.03	0.033	C	0.033	EPA RSL
ENDOSULFAN I ⁽⁸⁾	959-98-8	370	n	37	370	n	37	EPA RSL
ENDOSULFAN II ⁽⁸⁾	9	370	n	37	370	n	37	EPA RSL
ENDOSULFAN SULFATE ⁽⁸⁾	1031-07-8	370	n	37	370	n	37	EPA RSL
ENDRIN ENDRIN ALDEHYDE ⁽⁹⁾	72-20-8	18	n	1.8	18	n	1.8	EPA RSL
ENDRIN KETONE ⁽⁹⁾	7421-93-4	18	n	1.8	18	n	1.8	EPA RSL
ENDRIN KETONE ⁽⁹⁾ GAMMA-BHC (LINDANE)	5 58-89-9	18 0.52	n	1.8 0.52	18 0.56	n	1.8 0.56	EPA RSL EPA RSL
GAMMA-CHLORDANE ⁽⁷⁾	58-89-9	1.6	c c	1.6	1.8	C C	1.8	EPA RSL
HEPTACHLOR	76-44-8	0.11	C	0.11	0.12	C	0.12	EPA RSL
HEPTACHLOR EPOXIDE	1024-57-3	0.053	С	0.053	0.059	С	0.12	EPA RSL
METHOXYCHLOR	72-43-5	310	n	31	310	n	31	EPA RSL
TOXAPHENE	8001-35-2	0.44	С	0.44	0.48	C	0.48	EPA RSL
TCL PCBs								
AROCLOR-1016	12674-11-	3.9	n	0.39	4.0	n	0.40	EPA RSL
AROCLOR-1221	11104-28-	0.14	С	0.14	0.15	С	0.15	EPA RSL
AROCLOR-1232	11141-16-	0.14	С	0.14	0.15	С	0.15	EPA RSL
AROCLOR-1242	53469-21-	0.22	С	0.22	0.24	С	0.24	EPA RSL
AROCLOR-1248	12672-29-	0.22	С	0.22	0.24	С	0.24	EPA RSL
AROCLOR-1254	11097-69-	1.1	n	0.11	1.1	n	0.11	EPA RSL
AROCLOR-1260 AROCLOR-1262	11096-82- 37324-23-5	0.22 NC	C	0.22 NC	0.24 NC	C	0.24 NC	EPA RSL EPA RSL
AROCLOR-1262 AROCLOR-1268	11100-14-4	NC NC		NC NC	NC NC		NC NC	EPA RSL
EXPLOSIVES		INC		140	NO		INC	LIANOL
1,3,5-Trinitrobenzene	99-35-4	2200	n	220	2200	n	220	EPA RSL
1,3-Dinitrobenzene	99-65-0	6.1	n	0.61	6.2	n	0.62	EPA RSL
2,4-Dinitrotoluene	121-14-2	1.6	С	1.6	1.7	С	1.7	EPA RSL

HUMAN HEALTH SOIL SCREENING VALUES

Chemical	CAS#	EPA Residential Soil Direct Contact - Nov. 2013 (mg/kg)	Basis	Adjusted EPA Residential Soil Direct Contact - Nov. 2013 (mg/kg)	EPA Residential Soil Direct Contact - May 2014 (mg/kg)	Basis	Adjusted EPA Residential Soil Direct Contact - May 2014 (mg/kg)	PAL Reference
2,6-Dinitrotoluene	606-20-2	0.33	С	0.33	0.36	С	0.36	EPA RSL
Nitrobenzene	98-95-3	4.8	С	4.8	5.1	С	5.1	EPA RSL
2,4,6-Trinitrotoluene	118-96-7	36	n	3.6	36	n	3.6	EPA RSL
2-Amino-4,6-Dinitrotoluene	35572-78-2	150	n	15	150	n	15	EPA RSL
2-Nitrotoluene	88-72-2	2.9	С	2.9	3.2	С	3.2	EPA RSL
3-Nitrotoluene	99-08-1	6.1	n	0.61	6.2	n	0.62	EPA RSL
3,5-Dinitroaniline	618-87-1	NC		NC	NC		NC	EPA RSL
4-Amino-2,6-Dinitrotoluene	19406-51-	150	n	15	150	n	15	EPA RSL
4-Nitrotoluene	99-99-0	240	n	24	250	n	25	EPA RSL
HMX	2691-41-0	3800	n	380	3800	n	380	EPA RSL
Tetryl	479-45-8	120	n	12	120	n	12	EPA RSL
RDX	121-82-4	5.6	С	5.6	6	С	6.0	EPA RSL
PETN	78-11-5	120	n	12	120	n	12	EPA RSL
Nitroglycerin	55-63-0	6.1	n	0.61	6.2	n	0.62	EPA RSL

The USEPA RSL (May, 2014) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

Screening values for sediment will be the same as for soil.

- Footnotes:

 1) The value for hexavalent chromium is presented.
- 3) The value presented is for vanadium and compounds.
 3) The value for 1,3-dichloropropene is presented.
 4) The value for 4-nitroaniline is presented.
 5) The value for accepththene is presented.

- 6) The value for pyrene is presented.
- 7) The value for chlordane is presented.8) The value for endosulfan is presented.
- 9) The value for endrin is presented.

Acronyms:

c- carcinogenic CAS - Chemical Abstract Service

EPA - United States Environmental Protection Agency EPA - United States Environmental Protect mg/kg - milligrams per kilogram n - noncarcinogenic NC - No Criteria PAL - Project Action Limit PCB - Polychlorinated Biphenyl RSL - Regional Screening Level SVOC - Semi-Volatile Organic Compound TAL - Target Analyte List TCL - Target Compound List VOC - Volatile Organic Compound

Chemical	CAS#	EPA Residential Tap Water - May 2014 (µg/L)	Basis	Adjusted EPA Residential Tap Water - May 2014 (µg/L)	PAL Reference	
METALS						
ALUMINUM	7429-90-5	20000	n	2000	Tapwater RS	
ANTIMONY	7440-36-0	7.8	n	0.78	Tapwater RS	
ARSENIC BARIUM	7440-38-2 7440-39-3	0.052 3800	C	0.052 380	Tapwater RS Tapwater RS	
BERYLLIUM	7440-39-3	25	n n	2.5	Tapwater RS	
CADMIUM	7440-41-7	9.2	n	0.92	Tapwater RS	
CALCIUM	7440-70-2	NC		NC		
CHROMIUM	7440-47-3	22000	n	2200	Tapwater RS	
CHROMIUM ⁽¹⁾	7440-47-3	0.035	С	0.035	Tapwater RS	
COBALT	7440-48-4	6	n	0.6	Tapwater RS	
COPPER	7440-50-8	800	n	80	Tapwater RS	
RON	7439-89-6	14000	n	1400	Tapwater RS	
EAD	7439-92-1	15	- "	15	MCL	
MERCURY	7439-97-6	0.63	n	0.063	Tapwater RS	
MAGNESIUM	7439-95-4	NC		NC NC		
MANGANESE	7439-96-5	430	n	43	Tapwater RS	
NICKEL	7440-02-0	390	n	39	Tapwater RS	
POTASSIUM	7440-09-7	NC		NC		
SELENIUM	7782-49-2	100	n	10	Tapwater RS	
SILVER	7440-22-4	94	n	9.4	Tapwater RS	
ODIUM	7440-23-5	NC		NC		
THALLIUM	7440-28-0	0.2	n	0.02	Tapwater RS	
/ANADIUM ⁽²⁾	7440-62-2	86	n	8.6	Tapwater RS	
ZINC	7440-66-6	6000	n	600	Tapwater RS	
CL VOCs						
,1,1-TRICHLOROETHANE	71-55-6	8000	n	800	Tapwater RS	
,1,2-TRICHLORO-1,2,2-TRIFLUORO-ETHANE	76-13-1	55000	n	5500	Tapwater RS	
,1,2,2- TETRACHLORETHANE	79-34-5	0.076	C	0.076	Tapwater RS	
,1,2- TRICHLOROETHANE	79-00-5	0.28	c	0.041	Tapwater RS	
,1- DICHLOROETHANE	75-34-3	2.7	C	2.7	Tapwater RS	
,1-DICHLOROETHENE	75-35-4	280	n	28	Tapwater RS	
,2,3-TRICHLOROBENZENE	87-61-6	7	n	0.7	Tapwater RS	
,2,4-TRICHLOROBENZENE	120-82-1	1.1	С	0.4	Tapwater RS	
,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.00033	c	0.00033	Tapwater RS	
,2-DIBROMOETHANE	106-93-4	0.0075	С	0.0075	Tapwater RS	
,2- DICHLOROBENZENE	95-50-1	300	n	30	Tapwater RS	
2- DICHLOROETHANE	107-06-2	0.17	С	0.17	Tapwater RS	
2-DICHLOROPROPANE	78-87-5	0.44	С	0.44	Tapwater RS	
3-DICHLOROBENZENE	541-73-1	NC		NC		
4- DICHLOROBENZENE	106-46-7	0.48	С	0.48	Tapwater RS	
4-DIOXANE	123-91-1	0.78	С	0.78	Tapwater RS	
-BUTANONE	78-93-3	5600	n	560	Tapwater RS	
-HEXANONE	591-78-6	38	n	3.8	Tapwater RS	
-METHYL-2-PENTANONE	108-10-1	1200	n	120	Tapwater RS	
CETONE	67-64-1	14000	n	1400	Tapwater RS	
BENZENE	71-43-2	0.45	С	0.45	Tapwater RS	
ROMODICHLOROMETHANE	75-27-4	0.13	С	0.13	Tapwater RS	
BROMOCHLOROMETHANE	74-97-5	83	n	8.3	Tapwater RS	
ROMOFORM	75-25-2	9.2	С	9.2	Tapwater RS	
ROMOMETHANE	74-83-9	7.5	n	0.75	Tapwater RS	
ARBON DISULFIDE	75-15-0	810	n	81	Tapwater RS	
ARBON TETRACHLORIDE	56-23-5	0.45	С	0.45	Tapwater RS	
CHLOROBENZENE	108-90-7	78	n	7.8	Tapwater RS	
HLOROETHANE	75-00-3	21000	n	2100	Tapwater RS	
HLOROFORM	67-66-3	0.22	С	0.22	Tapwater RS	
HLOROMETHANE	74-87-3	190	n	19	Tapwater RS	
IS-1,2- DICHLOROETHENE	156-59-2	36	n	3.6	Tapwater RS	
IS-1,3- DICHLOROPROPENE ⁽³⁾	10061-01-5	0.47	С	0.47	Tapwater RS	
YCLOHEXANE	110-82-7	13000	n	1300	Tapwater RS	
IBROMOCHLOROMETHANE	124-48-1	0.17	С	0.17	Tapwater RS	
ICHLORODIFLUOROMETHANE	75-71-8	200	n	20	Tapwater RS	
THYLBENZENE	100-41-4	1.5	С	1.5	Tapwater RS	
SOPROPYLBENZENE	98-82-8	450	n	45	Tapwater RS	
ETHYL ACETATE	79-20-9	20000	n	2000	Tapwater RS	
IETHYLCYCLOHEXANE	108-87-2	NC		NC		
ETHYLENE CHLORIDE	75-09-2	11	С	11	Tapwater RS	
ETHYL TERT-BUTYL ETHER	1634-04-4	14	С	14	Tapwater RS	
TYRENE	100-42-5	1200	n	120	Tapwater RS	
ETRACHLOROETHENE	127-18-4	11	С	4.1	Tapwater RS	
OLUENE	108-88-3	1100	n	110	Tapwater RS	
RANS-1,2- DICHLOROETHENE	156-60-5	360	n	36	Tapwater RS	
RANS-1,3-DICHLOROPROPENE ⁽³⁾	10061-02-6	0.47	С	0.47	Tapwater RS	
RICHLOROETHENE	79-01-6	0.49	С	0.28	Tapwater RS	
RICHLOROFLUOROMETHANE	75-69-4	1100	n	110	Tapwater RS	
NYL CHLORIDE	75-01-4	0.019	С	0.019	Tapwater RS	
-XYLENE	95-47-6	190	n	19	Tapwater RS	
,p-XYLENE	179601-23-1	190	n	19	Tapwater RS	
CL SVOCs						
1'-BIPHENYL	92-52-4	0.83	n	0.083	Tapwater RS	
2,4,5-TETRACHLOROBENZENE	95-94-3	1.7	n	0.17	Tapwater RS	
2-OXYBIS(1-CHLOROPROPANE)	108-60-1	0.36	С	0.36	Tapwater RS	
,3,4,6-TETRACHLOROPHENOL	58-90-2	240	n	24	Tapwater RS	
4,5-TRICHLOROPHENOL	95-95-4	1200	n	120	Tapwater RS	
4,6-TRICHLOROPHENOL	88-06-2	4	C	1.2	Tapwater RS	
4-DICHLOROPHENOL	120-83-2	46	n	4.6	Tapwater RS	
,4-DIMETHYLPHENOL	105-67-9	360	n	36	Tapwater RS	
,4-DINITROPHENOL	51-28-5	39	n	3.9	Tapwater RS	
,4-DINITROTOLUENE	121-14-2	0.24	С	0.24	Tapwater RS	
,6-DINITROTOLUENE	606-20-2	0.048	С	0.048	Tapwater RS	
				75	Tapwater RS	

Chemical	CAS#	EPA Residential Tap Water - May 2014 (μg/L)	Basis	Adjusted EPA Residential Tap Water - May 2014 (µg/L)	PAL Reference
TCL SVOCs (continued)	05.57.0	04		0.4	T
2-CHLOROPHENOL 2-METHYLNAPHTHALENE	95-57-8 91-57-6	91 36	n n	9.1 3.6	Tapwater RSL Tapwater RSL
2-METHYLPHENOL	95-48-7	930	n	93	Tapwater RSL
2-NITROANILINE	88-74-4	190	n	19	Tapwater RSL
2-NITROPHENOL	88-75-5	NC		NC	
3,3'-DICHLOROBENZIDINE	91-94-1	0.12	С	0.12	Tapwater RSL
3-NITROANILINE ⁽⁴⁾	99-09-2	3.8	С	3.8	Tapwater RSL
4,6-DINITRO-2-METHYLPHENOL 4-BROMOPHENYL-PHENYLETHER	534-52-1 101-55-3	1.5 NC	n 	0.15 NC	Tapwater RSL
4-CHLORO-3-METHYLPHENOL	59-50-7	1400	n	140	Tapwater RSL
4-CHLOROANILINE	106-47-8	0.36	C	0.36	Tapwater RSL
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NC		NC	
4-METHYLPHENOL	106-44-5	1900	n	190	Tapwater RSL
4-NITROANILINE	100-01-6	3.8	С	3.8	Tapwater RSL
4-NITROPHENOL	100-02-7	NC		NC	
ACENAPHTHENE ⁽⁵⁾	83-32-9	530	n	53	Tapwater RSL
ACENAPHTHYLENE ANTHRACENE	208-96-8 120-12-7	530 1800	n n	53 180	Tapwater RSL Tapwater RSL
ATRAZINE	1912-24-9	0.3	C	0.3	Tapwater RSL
BENZALDEHYDE	100-52-7	1900	n	190	Tapwater RSL
BENZO (A) ANTHRACENE	56-55-3	0.034	С	0.034	Tapwater RSL
BENZO (A) PYRENE	50-32-8	0.0034	С	0.0034	Tapwater RSL
BENZO (B) FLUOROANTHENE	205-99-2	0.034	С	0.034	Tapwater RSL
BENZO (G,H,I) PERYLENE ⁽⁶⁾	191-24-2	120	n	12	Tapwater RSL
BENZO (K) FLUOROANTHENE	207-08-9	0.34	С	0.34	Tapwater RSL
BIS(2-CHLOROETHOXY) METHANE	111-91-1	59	n	5.9	Tapwater RSL
BIS-(2-CHLOROETHYL) ETHER	111-44-4	0.014	С	0.014	Tapwater RSL
BIS(2-ETHYLHEXYL) PHTHALATE BUTYLBENZYLPHTHALATE	117-81-7 85-68-7	5.6 16	C C	5.6 16	Tapwater RSL Tapwater RSL
CAPROLACTAM	105-60-2	9900	n	990	Tapwater RSL
CARBAZOLE	86-74-8	NC		NC NC	
CHRYSENE	218-01-9	3.4	С	3.4	Tapwater RSL
DIBENZO (A,H)-ANTHRACENE	53-70-3	0.0034	С	0.0034	Tapwater RSL
DIBENZOFURAN	132-64-9	7.9	n	0.79	Tapwater RSL
DIETHYLPHTHALATE	84-66-2	15000	n	1500	Tapwater RSL
DIMETHYLPHTHALATE	131-11-3	NC		NC	
DI-N-BUTYLPHTHALATE	84-74-2	900	n	90	Tapwater RSL
DI-N-OCTYLPHTHALATE FLUORANTHENE	117-84-0 206-44-0	200 800	n n	20 80	Tapwater RSL Tapwater RSL
FLUORENE	86-73-7	290	n	29	Tapwater RSL
HEXACHLOROBENZENE	118-74-1	0.049	C	0.049	Tapwater RSL
HEXACHLOROBUTADIENE	87-68-3	0.3	С	0.3	Tapwater RSL
HEXACHLOROCYCLOPENTADIENE	77-47-4	31	n	3.1	Tapwater RSL
HEXACHLOROETHANE	67-72-1	0.9	С	0	Tapwater RSL
INDENO (1,2,3-CD)-PYRENE	193-39-5	0.034	С	0.69	Tapwater RSL
ISOPHORONE	78-59-1	78	С	78	Tapwater RSL
NAPHTHALENE NITROBENZENE	91-20-3 98-95-3	0.17 0.14	C	0.17 0.14	Tapwater RSL Tapwater RSL
N-NITROSO DIPHENYLAMINE	86-30-6	12	С	12	Tapwater RSL
N-NITROSO-DI-N PROPYLAMINE	621-64-7	0.011	C	0.011	Tapwater RSL
PENTACHLOROPHENOL	87-86-5	0.04	С	0.04	Tapwater RSL
PHENANTHRENE ⁽⁶⁾	85-01-8	120	n	12	Tapwater RSL
PHENOL	108-95-2	5800	n	580	Tapwater RSL
PYRENE	129-00-0	120	n	12	Tapwater RSL
EXPLOSIVES	1 00 07 1	F00		50	T 50:
1,3,5-TRINITROBENZENE	99-35-4	590	n	59	Tapwater RSL
1,3-DINITROBENZENE 2,4-DINITROTOLUENE	99-65-0 121-14-2	2 0.24	n c	0.2 0.24	Tapwater RSL Tapwater RSL
2,6-DINITROTOLUENE	606-20-2	0.048	C	0.048	Tapwater RSL
NITROBENZENE	98-95-3	0.14	C	0.14	Tapwater RSL
2,4,6-TRINITROTOLUENE	118-96-7	2.5	С	0.98	Tapwater RSL
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	39	n	3.9	Tapwater RSL
2-NITROTOLUENE	88-72-2	0.31	С	0.31	Tapwater RSL
3-NITROTOLUENE	99-08-1	1.7	n	0.17	Tapwater RSL
3,5-DINITROANILINE	618-87-1	NC 20		NC 2.0	
4-AMINO-2,6-DINITROTOLUENE 4-NITROTOLUENE	1946-51-0 99-99-0	39 4.2	n C	3.9 4.2	Tapwater RSL Tapwater RSL
HMX	2691-41-0	1000	n	100	Tapwater RSL
TETRYL	479-45-8	39	n	3.9	Tapwater RSL
RDX	121-82-4	0.7	C	0.7	Tapwater RSL
PETN	78-11-5	19	С	3.9	Tapwater RSL
NITROGLYCERIN	55-63-0	2	n	0.2	Tapwater RSL
PCBs					
AROCLOR-1016	12674-11-2	1.1	С	0.14	Tapwater RSL
AROCLOR-1221	11104-28-2	0.0046	С	0.0046	Tapwater RSL
AROCLOR-1232	11141-16-5	0.0046	c	0.0046	Tapwater RSL
AROCLOR-1242	53469-21-9	0.039	С	0.039	Tapwater RSL
AROCLOR-1248	12672-29-6	0.039	С	0.039	Tapwater RSL
AROCLOR-1254	11097-69-1	0.039	С	0.039	Tapwater RSL
AROCLOR-1260	11096-82-5	0.039	С	0.039	Tapwater RSL
AROCLOR-1262	37324-23-5	NC		NC	
AROCLOR-1202	01024 20 01				

Chemical	CAS#	EPA Residential Tap Water - May 2014 (µg/L)	Basis	Adjusted EPA Residential Tap Water - May 2014 (µg/L)	PAL Reference
TCL Pesticides					
4,4'-DDD	72-54-8	0.031	С	0.031	Tapwater RSL
4,4'-DDE	72-55-9	0.23	С	0.23	Tapwater RSL
4,4'-DDT	50-29-3	0.23	С	0.23	Tapwater RSL
ALDRIN	309-00-2	0.0046	С	0.0046	Tapwater RSL
ALPHA-BHC	319-84-6	0.0071	С	0.0071	Tapwater RSL
ALPHA-CHLORDANE ⁽⁷⁾	5103-71-9	0.22	С	0.22	Tapwater RSL
BETA-BHC	319-85-7	0.025	С	0.025	Tapwater RSL
DELTA-BHC ⁽⁸⁾	319-86-8	0.0071	С	0.0071	Tapwater RSL
DIELDRIN	60-57-1	0.0017	С	0.0017	Tapwater RSL
ENDOSULFAN I ⁽⁹⁾	959-98-8	100	С	100	Tapwater RSL
ENDOSULFAN II ⁽⁹⁾	9	100	n	10	Tapwater RSL
ENDOSULFAN SULFATE ⁽⁹⁾	1031-07-8	100	n	10	Tapwater RSL
ENDRIN	72-20-8	2.3	n	0.23	Tapwater RSL
ENDRIN ALDEHYDE(10)	7421-93-4	2.3	n	0.23	Tapwater RSL
ENDRIN KETONE ⁽¹⁰⁾	5	2.3	n	0.23	Tapwater RSL
GAMMA-BHC (LINDANE)	58-89-9	0.041	С	0.041	Tapwater RSL
GAMMA-CHLORDANE ⁽⁷⁾	5103-74-2	0.22	С	0.22	Tapwater RSL
HEPTACHLOR	76-44-8	0.002	С	0.002	Tapwater RSL
HEPTACHLOR EPOXIDE	1024-57-3	0.0038	С	0.0038	Tapwater RSL
METHOXYCHLOR	72-43-5	37	n	3.7	Tapwater RSL
TOXAPHENE	8001-35-2	0.015	С	0.015	Tapwater RSL

The USEPA RSL (May, 2014) residential soil screening level for noncarcinogens adjusted by dividing by 10, equivalent to a HQ of 0.1. The residential soil screening level for carcinogens (not adjusted) is equivalent to an ILCR of 1E-6.

- Footnotes:

 1) The value for hexavalent chromium is presented.

 2) The value presented is for vanadium and compounds.
- 3) The value for 1,3-dichloropropene is presented.
- 4) The value for 4-nitroaniline is presented.5) The value for acenaphthene is presented.
- 6) The value for pyrene is presented.
- 7) The value for chlordane is presented. 8) The value for alpha-BHC is presented.
- 9) The value for endosulfan is presented.
- 10) The value for endrin is presented.

Acronyms:

c- carcinogenic CAS - Chemical Abstract Service

mg/kg - milligrams per kilogram

n - noncarcinogenic NC - No Criteria

PAL - Project Action Limit

PCB - Polychlorinated Biphenyl RSL - Regional Screening Level SVOC - Semi-Volatile Organic Compound

TAL - Target Analyte List
TCL - Target Compound List
USEPA - United States Environmental Protection Agency

VOC - Volatile Organic Compound

Table 1: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario (mg/kg)
Revision of May 8, 2013

CAS No Dash	Chemical	Leaching to Groundwater mg/kg)	Soil Residential (mg/kg)	Soil Park User(mg/Kg)	Soil Commercial Worker (mg/kg)	Soil Construction Worker (mg/kg)	Undeveloped ME Background UPL (mg/kg)	Rural Developed ME Background UPL (mg/kg)	Urban Developed ME Background UPL (mg/kg)	Urban Fill ME Background UPL (mg/kg)
630206	1,1,1,2-Tetrachloroethane	0.20	550	910	1,800	9,300				
71556	1,1,1-Trichloroethane	520	10,000	10,000	10,000	10,000				
79345	1,1,2,2-Tetrachloroethane	0.026	71	120	240	2,200				
79005	1,1,2-Trichloroethane		250	410	830	5,400				
92524	1,1-Biphenyl		8,500	10,000	10,000	10,000				
75343	1,1-Dichloroethane	1.0	2,500	4,200	8,400	10,000				
75354	1,1-Dichloroethene	2.5	8,500	10,000	10,000	10,000				
87616	1,2,3-Trichlorobenzene		1,700	2,800	10,000	420				
120821	1,2,4-Trichlorobenzene	8.6	490	820	1,600	430				
96128	1,2-Dibromo-3-chloropropane		3.2	5.4	47	51				
95501	1,2-Dichlorobenzene	11	5,100	8,500	10,000	10,000				
107062	1,2-Dichloroethane	0.036	160	260	520	3,700				
156592	1,2-Dichloroethene (cis)	0.14	340	570	3,400	6,200				
156605	1,2-Dichloroethene (trans)	2.4	3,400	5,700	10,000	10,000				
78875	1,2-Dichloropropane		390	650	1,300	5,500				
528290	1,2-Dinitrobenzene		13	22	100	240				
106990	1,3-Butadiene		4.2	7.0	14	130				
541731	1,3-Dichlorobenzene	0.075	34	57	340	6,200				
142289	1,3-Dichloropropane		3,400	5,700	10,000	10,000				
542756	1,3-Dichloropropene		140	240	480	4,300				
99650	1,3-Dinitrobenzene		13	22	100	120				
106467	1,4-Dichlorobenzene	4.3	2,600	4,400	8,800	10,000				
100254	1,4-Dinitrobenzene		13	22	100	240				
123911	1,4-Dioxane		110	180	290	3,300				
75683	1-Chloro-1,1-difluoroethane		10,000	10,000	10,000	10,000				
93765	2,4,5-T		1,300	2,200	10,000	10,000				
93721	2,4,5-TP		1,100	1,800	8,200	1,900				
95954	2,4,5-Trichlorophenol		10,000	10,000	10,000	10,000				
88062	2,4,6-Trichlorophenol		130	220	1,000	240				
118967	2,4,6-Trinitrotoluene		67	110	510	120				
120832	2,4-Dichlorophenol		400	670	3,100	710				
105679	2,4-Dimethylphenol		2,700	4,400	10,000	10,000				
51285	2,4-Dinitrophenol		270	440	2,100	4,800				
121142	2,4-Dinitrotoluene		35	58	93	480				
576261	2,6-Dimethylphenol		80	130	620	1,400				
606202	2,6-Dinitrotoluene		16	26	42	490				
95578	2-Chlorophenol		850	1,400	8,500	2,500				

Table 1: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario (mg/kg)
Revision of May 8, 2013

CAS No Dash	Chemical	Leaching to Groundwater mg/kg)	Soil Residential (mg/kg)	Soil Park User(mg/Kg)	Soil Commercial Worker (mg/kg)	Soil Construction Worker (mg/kg)	Undeveloped ME Background UPL (mg/kg)	Rural Developed ME Background UPL (mg/kg)	Urban Developed ME Background UPL (mg/kg)	Urban Fill ME Background UPL (mg/kg)
95487	2-Cresol		6,700	10,000	10,000	10,000				
91576	2-Methylnaphthalene	3.6	500	830	3,600	600		0.16	0.089	0.41
91941	3,3-Dichlorobenzidine		24	40	64	740				
108394	3-Cresol		6,700	10,000	10,000	10,000				
106478	4-Chloroaniline		54	90	140	120				
106445	4-Cresol		670	1,100	5,100	10,000				
83329	Acenaphthene	170	7,500	10,000	10,000	9,800		0.10	0.20	3.5
208968	Acenaphthylene	68	7,500	10,000	10,000	10,000		0.32	0.39	1.4
67641	Acetone		10,000	10,000	10,000	10,000				
75058	Acetonitrile		10,000	10,000	10,000	3,200				
107028	Acrolein		85	140	850	1,200				
107131	Acrylonitrile		26	44	88	800				
15972608	Alachlor		190	320	510	2,400				
309002	Aldrin		0.64	1.1	1.7	10				
107051	Allyl chloride		680	1,100	2,300	10,000				
7429905	Aluminum		170,000	280,000		310,000				
120127	Anthracene	2,400	\	10,000		3,800		0.29	0.40	6.7
7440360	Antimony		68	110		120				
12674112	Aroclor 1016		4.9	8.2	12	46				
7440382	Arsenic		1.4	2.3	4.2	42	16			
1912249	Atrazine		47	78	120	710				
7440393	Barium		10,000	10,000		10,000	470			
71432	Benzene	0.51	85	140		150				
56553	Benzo(a)anthracene	10,000	2.6	4.4	35	430		0.86	1.6	27
50328	Benzo(a)pyrene	10,000		0.44		43		1.5	_	5.2
205992	Benzo(b)fluoranthene	10,000		4.4				1.3		
191242	Benzo(g,h,i)perylene	10,000		6,200		10,000		0.57		
207089	Benzo(k)fluoranthene	10,000		44		4,300		0.69	+	
65850	Benzoic acid		10,000	10,000		10,000				
100447	Benzyl chloride		83	140		620				
7440417	Beryllium		340	570		620				
111444	Bis(2-chloroethyl)ether		10	16		250				
117817	Bis(2-Ethylhexyl)phthalate		770	1,300		10,000				
75274	Bromodichloromethane		230	380		6,200				
75252	Bromoform		1,400	2,300		10,000				
74839	Bromomethane		240	400		·				
85687	Butyl benzyl phthalate		5,700	9,500	· ·	10,000				
DEP2041	C11-C22 Aromatics	460		1,200		10,000				
DEP2042	C19-C36 Aliphatics	10,000		10,000						

Table 1: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario (mg/kg)
Revision of May 8, 2013

CAS No Dash	Chemical	Leaching to Groundwater mg/kg)	Soil Residential (mg/kg)	Soil Park User(mg/Kg)	Soil Commercial Worker (mg/kg)	Soil Construction Worker (mg/kg)	Undeveloped ME Background UPL (mg/kg)	Rural Developed ME Background UPL (mg/kg)	Urban Developed ME Background UPI (mg/kg)	Rackground HPI
DEP2038	C5-C8 Aliphatics	1,600	1,400	2,300	10,000	10,000				
DEP2040	C9-C10 Aromatics	75	750	1,200	5,500	10,000				
DEP2039	C9-C12 Aliphatics	10,000	2,700	4,400	10,000	10,000				
DEP2043	C9-C18 Aliphatics	10,000	2,700	4,400	10,000	10,000				
7440439	Cadmium		11	18	94	19	0.26			
86748	Carbazole		540	900	1,400	10,000				0.53
75150	Carbon disulfide		10,000	10,000	10,000	10,000				
56235	Carbon tetrachloride	0.55	200	340	680	2,800				
57749	Chlordane		36	60	110	170				
115286	Chlorendic acid		120	200	320	3,700				
108907	Chlorobenzene	1.1	3,400	5,700	10,000	10,000				
67663	Chloroform		460	760	1,500	10,000				
74873	Chloromethane		10,000	10,000	10,000	10,000				
16065831	Chromium (+3)		10,000	10,000	10,000	10,000				
18540299	Chromium (+6)		510	850	5,100	2,800				
218019	Chrysene	10,000	260	440	3,500	10,000		1.0	2.3	6.4
7440484	Cobalt		51	85	510	920	15			
7440508	Copper		2,400	4,000	10,000	4,300	23			
57125	Cyanide		100	170	1,000	1,900				
72548	DDD		45	75	120	1,400				
72559	DDE		32	53	85	980				
50293	DDT		38	64	120	140				
53703	Dibenz(a,h)anthracene	10,000	0.26	0.44	3.5	43		0.32	0.23	3 4.5
132649	Dibenzofuran		130	220	1,000	950				
124481	Dibromochloromethane		170	280	560	4,300				
84742	Dibutyl phthalate		10,000	10,000	10,000	10,000				
75718	Dichlorodifluoromethane		10,000	10,000						
60571	Dieldrin		0.68	1.1	1.8	21				
84662	Diethyl phthalate		10,000	10,000	10,000	10,000				
88857	Dinoseb		130	220	1,000	240				
1746016	Dioxin-Like Compounds - TEQ		0.00010	0.00017		0.0031				
115297	Endosulfan		800	1,300	6,200	1,400				
72208	Endrin		40	67						
75003	Ethyl chloride		1,700	2,800	10,000	10,000				
100414	Ethylbenzene	0.81		2,200						
106934	Ethylene dibromide		7.1	12		180				
206440	Fluoranthene	10,000		8,300				2.0	3.2	2 10
86737	Fluorene	120		8,300				0.22		

Table 1: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario (mg/kg)
Revision of May 8, 2013

CAS No Dash	Chemical	Leaching to Groundwater mg/kg)	Soil Residential (mg/kg)	Soil Park User(mg/Kg)	Soil Commercial Worker (mg/kg)	Soil Construction Worker (mg/kg)	Undeveloped ME Background UPL (mg/kg)	Rural Developed ME Background UPL (mg/kg)	Urban Developed ME Background UPL (mg/kg)	Urban Fill ME Background UPL (mg/kg)
76448	Heptachlor		1.3	2.2	6.4	24				
1024573	Heptachlor epoxide		1.2	2.0	3.2	3.1				
118741	Hexachlorobenzene		6.8	11	. 18	190				
87683	Hexachlorobutadiene		130	220	370	240				
319846	Hexachlorocyclohexane, alpha (alpha-BHC)		1.7	2.9	4.6	53				
319857	Hexachlorocyclohexane, beta (beta-BHC)		6.0	10	16	140				
58899	Hexachlorocyclohexane, gamma (Lindane)		0.61	1.0	5.4	2.8				
67721	Hexachloroethane		93	160	720	2,400				
121824	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)		98	160	260	3,000				
193395	Indeno(1,2,3-cd)pyrene	10,000	2.6	4.4	35	430		0.40	0.74	3.3
7439896	Iron		120,000	200,000	1,000,000	220,000				
7439921	Lead	10,000	340	530		950				
121755	Malathion	,	2,700	4,400		4,800	_			
7439965	Manganese		4,100	6,800	*	7,400				
7487947	Mercuric chloride & other inorganic mercury compounds		51	85	510	930				
72435	Methoxychlor		670	1,100	5,100	1,200				
78933	Methyl ethyl ketone		10,000	10,000		10,000				
108101	Methyl isobutyl ketone		10,000	10,000		10,000				
80626	Methyl methacrylate		10,000	10,000		10,000				
1634044	Methyl tert-butyl ether	0.19	5,100	8,500		10,000				
75092	Methylene chloride		1,000	1,700		10,000				
7439987	Molybdenum		850	1,400						
91203	Naphthalene	1.7	2,500	4,200		· ·		0.11	0.22	0.82
7440020	Nickel		510	850	5,100	930	39			
106945	n-Propyl bromide		190	310		710				
2691410	Octahydro-1,3,5,7-tetranitro- 1,3,5,7-tetra (HMX)		6,700	10,000	10,000	10,000				
117840	Octyl Phthalate, di-n-		1,600	2,700	10,000	2,900				
56382	Parathion		800	1,300	6,200	1,400				
1336363	PCBs		2.4	4.1	. 12	6.5				
87865	Pentachlorophenol		20							
14797730	Perchlorate		20							

Table 1: Maine Remedial Action Guidelines for the Soil Exposure Pathway, by Exposure Scenario (mg/kg)
Revision of May 8, 2013

CAS No Dash	Chemical	Leaching to Groundwater mg/kg)	Soil Residential (mg/kg)	Soil Park User(mg/Kg)	Soil Commercial Worker (mg/kg)	Soil Construction Worker (mg/kg)	Undeveloped ME Background UPL (mg/kg)	Rural Developed ME Background UPL (mg/kg)	Urban Developed ME Background UPL (mg/kg)	Urban Fill ME Background UPL (mg/kg)
85018	Phenanthrene	97	3,700	6,200	10,000	8,900		0.83	1.6	6.1
108952	Phenol		10,000	10,000	10,000	10,000				
129000	Pyrene	10,000	3,700	6,200	10,000	10,000		2.0	2.8	9.5
7782492	Selenium		850	1,400	8,500	1,500	0.61			
7440224	Silver		850	1,400	8,500	1,500				
100425	Styrene		10,000	10,000	10,000	10,000				
127184	Tetrachloroethene	2.7	1,000	1,700	10,000	10,000				
298022	Thimet (Phorate)		27	44	210	48				
108883	Toluene	8.1	10,000	10,000	10,000	10,000				
79016	Trichloroethene	0.23	85	140	850	140				
75694	Trichlorofluoromethane		10,000	10,000	10,000	10,000				
7440622	Vanadium		1,200	2,000	10,000	2,200	100			
108054	Vinyl acetate		10,000	10,000	10,000	10,000				
593602	Vinyl bromide		10,000	10,000	10,000	1,300				
75014	Vinyl chloride	0.013	0.48	0.49	66	600				
1330207	Xylene	26	10,000	10,000	10,000	10,000				
7440666	Zinc		10,000	10,000	10,000	10,000	100			

Chemical	Chemical Abstract Service (CAS) No.	Final Ecological Screening Level	Source of Final Ecological Screening Level		
METALS (mg/kg)	(3.13)		•		
ALUMINUM	7429-90-5	50	ORNL Plant		
Antimony	7440-36-0	0.27	EPA SSL Wildlife		
Arsenic	7440-38-2	17	CCME Plant/Invert.		
BARIUM BERYLLIUM	7440-39-3	330 10	EPA SSL Invert		
CADMIUM	7440-41-7 7440-43-9	0.36	ORNL Plant EPA SSL Wildlife		
CALCIUM	7440-43-9	0.36 NA	NA NA		
CHROMIUM	7440-47-3	26	EPA SSL Wildlife		
CHROMIUM, hexavalent	18540-59-9	0.4	ORNL Invert		
COBALT	7440-48-4	13	EPA SSL Plant		
Copper	7440-50-8	28	EPA SSL Wildlife		
IRON	7439-89-6	200	ORNL Invert		
Lead	7439-92-1	11	EPA SSL Wildlife		
MERCURY	7439-97-6	0.013	LANL wildlife		
MAGNESIUM	7439-95-4	NA 200	NA FDA COL Plant		
MANGANESE NICKEL	7439-96-5 7440-02-0	220 38	EPA SSL Plant EPA SSL Plant		
POTASSIUM	7440-02-0	NA	NA NA		
SELENIUM	7782-49-2	0.52	EPA SSL Plant		
SILVER	7440-22-4	4.2	EPA SSL Wildlife		
SODIUM	7440-23-5	NA	NA NA		
THALLIUM	7440-28-0	0.032	LANL wildlife		
VANADIUM	7440-62-2	7.8	EPA SSL Wildlife		
Zinc	7440-66-6	46	EPA SSL Wildlife		
TCL VOCs (MG/KG)					
1,1,1-TRICHLOROETHANE	71-55-6	0.07	Target Value		
1,1,2-TRICHLORO-1,2,2-TRIFLUORO-ETHANE	76-13-1	NA	NA		
1,1,2,2- TETRACHLORETHANE	79-34-5	0.127	Region 5 Wildlife		
1,1,2- TRICHLOROETHANE 1,1- DICHLOROETHANE	79-00-5 75-34-3	0.4 0.02	Target Value Target Value		
1,1-DICHLOROETHENE	75-35-4	0.02	Target Value		
1,2,3-TRICHLOROBENZENE	87-61-6	20	ORNL Invert		
1,2,4-TRICHLOROBENZENE	120-82-1	11.1	Region 5 Wildlife		
1,2-DIBROMO-3-CHLOROPROPANE	96-12-8	0.0352	Region 5 Wildlife		
1,2-DIBROMOETHANE	106-93-4	1.23	Region 5 Wildlife		
1,2- DICHLOROBENZENE	95-50-1	0.92	LANL wildlife		
1,2- DICHLOROETHANE	107-06-2	0.02	Target Value		
1,2-DICHLOROPROPANE	78-87-5	0.002	Target Value		
1,3-DICHLOROBENZENE	541-73-1 106-46-7	0.73 0.88	LANL wildlife LANL wildlife		
1,4- DICHLOROBENZENE 1,4-DIOXANE	123-91-1	2.05	Region 5 Wildlife		
2-BUTANONE	78-93-3	360	LANL wildlife		
2-HEXANONE	591-78-6	0.36	LANL wildlife		
4-METHYL-2-PENTANONE	108-10-1	9.8	LANL wildlife		
ACETONE	67-64-1	1.2	LANL wildlife		
BENZENE	71-43-2	25	CCME Wildlife		
BROMODICHLOROMETHANE	75-27-4	0.54	Region 5 Wildlife		
BROMOCHLOROMETHANE	74-97-5	NA 15.0	NA		
BROMOFORM	75-25-2	15.9	Region 5 Wildlife		
BROMOMETHANE CARBON DISULFIDE	74-83-9	0.235	Region 5 Wildlife		
CARBON DISULFIDE CARBON TETRACHLORIDE	75-15-0 56-23-5	0.82 2.98	LANL wildlife Region 5 Wildlife		
CHLOROBENZENE	108-90-7	0.03	Target Value		
CHLOROETHANE	75-00-3	NA NA	NA NA		
CHLOROFORM	67-66-3	8	LANL wildlife		
CHLOROMETHANE	74-87-3	10.4	Region 5 Wildlife		
CIS-1,2- DICHLOROETHENE	156-59-2	0.2	Target Value		
CIS-1,3- DICHLOROPROPENE	10061-01-5	0.2	Target Value		
CYCLOHEXANE	110-82-7	NA 0.05	NA NA		
DIBROMOCHLOROMETHANE	124-48-1	2.05	Region 5 Wildlife		
DICHLORODIFLUOROMETHANE ETHYLBENZENE	75-71-8 100-41-4	39.5 5.16	Region 5 Wildlife Region 5 Wildlife		
ISOPROPYLBENZENE	98-82-8	5.16 NA	NA NA		
METHYL ACETATE	79-20-9	NA NA	NA NA		
METHYLCYCLOHEXANE	108-87-2	NA NA	NA NA		
METHYLENE CHLORIDE	75-09-2	2.6	LANL wildlife		
METHYL TERT-BUTYL ETHER	1634-04-4	NA	NA		
STYRENE	100-42-5	1.2	LANL Invert		
TETRACHLOROETHENE	127-18-4	0.002	Target Value		
TOLUENE	108-88-3	75	CCME		

Chemical	Chemical Abstract Service	Final Ecological Screening	Source of Final Ecological Screening Level		
TRANS-1,2- DICHLOROETHENE	(CAS) No. 156-60-5	Level 0.2	Target Value		
TRANS-1,3-DICHLOROPROPENE	10061-02-6	0.2	Target Value		
TRICHLOROETHENE	79-01-6	0.1	Target Value		
TRICHLOROFLUOROMETHANE	75-69-4	16.4	Region 5 Wildlife		
VINYL CHLORIDE	75-01-4	0.01	Target Value		
O-XYLENE	95-94-6	95	CCME Plant/Invert.		
m,p-XYLENE	179601-23-1	95	CCME Plant/Invert.		
TCL SVOCs (MG/KG)	Too =0 /		00111 01		
1,1'-BIPHENYL	92-52-4	60	ORNL Plant		
1,2,4,5-TETRACHLOROBENZENE 2.2-OXYBIS(1-CHLOROPROPANE)	95-94-3 108-60-1	2.02 19.9	Region 5 Wildlife Region 5 Wildlife		
2,3,4,6-TETRACHLOROPHENOL	58-90-2	0.199	Region 5 Wildlife		
2,4,5-TRICHLOROPHENOL	95-95-4	4	ORNL Plant		
2,4,6-TRICHLOROPHENOL	88-06-2	9.94	Region 5 Wildlife		
2,4-DICHLOROPHENOL	120-83-2	87.5	Region 5 Wildlife		
2,4-DIMETHYLPHENOL	105-67-9	NA	NA		
2,4-DINITROPHENOL	51-28-5	0.0609	Region 5 Wildlife		
2,4-DINITROTOLUENE	121-14-2	2.5	LANL wildlife		
2,6-DINITROTOLUENE	606-20-2	1.8	LANL wildlife		
2-CHLORONAPHTHALENE	91-58-7	0.0122	Region 5 Wildlife		
2-CHLOROPHENOL	95-57-8	0.39	LANL wildlife		
2-METHYLNAPHTHALENE	91-57-6	29	EPA SSL Invert		
2-METHYLPHENOL	95-48-7	0.05	Target Value		
2-NITROANILINE 2-NITROPHENOL	88-74-4 88-75-5	5.4 1.6	LANL wildlife Region 5 Wildlife		
3,3'-DICHLOROBENZIDINE	91-94-1	0.646	Region 5 Wildlife		
3-NITROANILINE	99-09-2	3.16	Region 5 Wildlife		
4,6-DINITRO-2-METHYLPHENOL	534-52-1	0.144	Region 5 Wildlife		
4-BROMOPHENYL-PHENYLETHER	101-55-3	NA	NA NA		
4-CHLORO-3-METHYLPHENOL	59-50-7	7.95	Region 5 Wildlife		
4-CHLOROANILINE	106-47-8	1	LANL Plant		
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NA	NA		
4-METHYLPHENOL	106-44-5	0.05	Target Value		
4-NITROANILINE	100-01-6	21.9	Region 5 Wildlife		
4-NITROPHENOL	100-02-7	5.12	Region 5 Wildlife		
ACENAPHTHENE	83-32-9	20	ORNL Plant		
ACENAPHTHYLENE	208-96-8	20	ORNL Plant		
ANTHRACENE	120-12-7	2.5	CCME Plant/Invert.		
ATRAZINE BENZALDEHYDE	1912-24-9 100-52-7	NA NA	NA NA		
BENZO (A) ANTHRACENE	56-55-3	1.1	EPA SSL Wildlife		
BENZO (A) PYRENE	50-32-8	1.1	EPA SSL Wildlife		
BENZO (B) FLUOROANTHENE	205-99-2	1.1	EPA SSL Wildlife		
BENZO (G,H,I) PERYLENE	191-24-2	1.1	EPA SSL Wildlife		
BENZO (K) FLUOROANTHENE	207-08-9	1.1	EPA SSL Wildlife		
BIS(2-CHLOROETHOXY) METHANE	111-91-1	0.302	Region 5 Wildlife		
BIS-(2-CHLOROETHYL) ETHER	111-44-4	23.7	Region 5 Wildlife		
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	0.02	LANL wildlife		
BUTYLBENZYLPHTHALATE	85-68-7	90	LANL wildlife		
CAPROLACTAM	105-60-2	NA	NA		
CARBAZOLE	86-74-8	80	LANL wildlife		
CHRYSENE	218-01-9	1.1	EPA SSL Wildlife		
DIBENZO (A,H)-ANTHRACENE DIBENZOFURAN	53-70-3 132-64-9	1.1 6.1	EPA SSL Wildlife LANL Plant		
DIETHYLPHTHALATE	84-66-2	24.8	Region 5 Wildlife		
DIMETHYLPHTHALATE	131-11-3	200	ORNL Plant		
DI-N-BUTYLPHTHALATE	84-74-2	0.011	LANL wildlife		
DI-N-OCTYLPHTHALATE	117-84-0	0.91	LANL wildlife		
FLUORANTHENE	206-44-0	29	EPA SSL Invert		
FLUORENE	86-73-7	29	EPA SSL Invert		
HEXACHLOROBENZENE	118-74-1	0.079	LANL wildlife		
HEXACHLOROBUTADIENE	87-68-3	0.0398	Region 5 Wildlife		
HEXACHLOROCYCLOPENTADIENE	77-47-4	0.755	Region 5 Wildlife		
HEXACHLOROETHANE	67-72-1	0.596	Region 5 Wildlife		
INDENO (1,2,3-CD)-PYRENE	193-39-5	1.1	EPA SSL Wildlife		
ISOPHORONE	78-59-1	139	Region 5 Wildlife		
NAPHTHALENE	91-20-3	1 1 0	LANL Plant		
NITROBENZENE N-NITROSO DIPHENYLAMINE	98-95-3 86-30-6	4.9 0.545	LANL wildlife Region 5 Wildlife		
N-NITROSO DIPHENT LAMINE N-NITROSO-DI-N PROPYLAMINE	621-64-7	0.545	Region 5 Wildlife		
PENTACHLOROPHENOL	87-86-5	2.1	EPA SSL Wildlife		
. Z OF ILOTO FILITOL	01 00 0	- .1	LI / COL WINGING		

Ohamiaal	Chemical	Final Ecological	Source of	
Chemical	Abstract Service (CAS) No.	Screening Level	Final Ecological Screening Level	
PHENANTHRENE	85-01-8	29	EPA SSL Invert	
PHENOL	108-95-2	20	CCME Plant/Invert.	
PYRENE	129-00-0	1.1	EPA SSL Wildlife	
EXPLOSIVES (MG/KG)	<u> </u>		•	
1,3,5-Trinitrobenzene	99-35-4	6.6	LANL wildlife	
1,3-Dinitrobenzene	99-65-0	0.073	LANL wildlife	
2,4-Dinitrotoluene	121-14-2	2.5	LANL wildlife	
2,6-Dinitrotoluene Nitrobenzene	606-20-2 98-95-3	1.8 4.9	LANL wildlife LANL wildlife	
2.4.6-Trinitrotoluene	118-96-7	6	Sunahara Plant	
2-Amino-4,6-Dinitrotoluene	35572-78-2	10	LANL wildlife	
2-Nitrotoluene	88-72-2	9.9	LANL wildlife	
3-Nitrotoluene	99-08-1	12	LANL wildlife	
3,5-Dinitroaniline	618-87-1	NA	NA	
4-Amino-2,6-Dinitrotoluene	1946-51-0	3.6	LANL wildlife	
4-Nitrotoluene HMX	99-99-0 2691-41-0	22 16	LANL wildlife Draft Eco SSL	
Tetryl	479-45-8	0.99	LANL wildlife	
RDX	121-82-4	12	LANL wildlife	
PETN	78-11-5	100	LANL wildlife	
Nitroglycerin	55-63-0	13	Draft Eco SSL	
PCBs (MG/KG)				
AROCLOR-1016	12674-11-2	1.3	CCME Wildlife	
AROCLOR-1221	11104-28-2	1.3	CCME Wildlife	
AROCLOR-1232	11141-16-5	1.3	CCME Wildlife	
AROCLOR-1242	53469-21-9	1.3	CCME Wildlife	
AROCLOR-1248	12672-29-6	1.3	CCME Wildlife	
AROCLOR-1254	11097-69-1	1.3	CCME Wildlife	
AROCLOR-1260	11096-82-5	1.3	CCME Wildlife	
AROCLOR-1262	37324-23-5	1.3	CCME Wildlife	
AROCLOR-1268	11100-14-4	1.3	CCME Wildlife	
TCL Pesticides (MG/KG)			•	
4,4'-DDD	72-54-8	0.021	EPA SSL Wildlife	
4,4'-DDE	72-55-9	0.021	EPA SSL Wildlife	
4,4'-DDT	50-29-3	0.021	EPA SSL Wildlife	
ALDRIN	309-00-2	0.00006	Target Value	
ALPHA-BHC	319-84-6	0.003	Target Value	
ALPHA-CHLORDANE	5103-71-9	0.00003	Target Value	
BETA-BHC	319-85-7	0.009	Target Value	
DELTA-BHC	319-86-8	9.94	Region 5 Wildlife	
DIELDRIN	60-57-1	0.0005	Target Value	
ENDOSULFAN I	959-98-8	0.00001	Target Value	
ENDOSULFAN II	33213-65-9	0.00001	Target Value	
ENDOSULFAN SULFATE	1031-07-8	0.00001	Target Value	
ENDRIN	72-20-8	0.00001	Target Value	
ENDRIN ALDEHYDE	7421-93-4	0.00004	Target Value	
ENDRIN KETONE	53494-70-5	0.00004	Target Value	
GAMMA-BHC (LINDANE)	58-89-9	0.00004	Target Value	
, ,	5103-74-2		Target Value	
GAMMA-CHLORDANE	76-44-8	0.00003	Ĭ	
HEPTACHLOR EDOVIDE		0.0007	Target Value	
HEPTACHLOR EPOXIDE	1024-57-3	0.0000002	Target Value	
METHOXYCHLOR	72-43-5	5	LANL wildlife	
TOXAPHENE	8001-35-2	4.1	LANL wildlife	

The selected ecological SSLs are the lowest of the selected benchmarks for plants, invertebrates, and wildlife.

- Screening Level Order of Preference for plants and invertebrates:

 1a. USEPA Eco SSL EPA Ecological Soil Screening Levels (EPA SSL Plant or Invert)
- 2. Draft Ecological Soil Screening Levels (SERDP, 2012) (Draft Eco SSL)

- 2. Draft Ediografi Soft Greening Eversi (Cerker , 202) (Draft Ediograf)
 3. CCME Canadian Council and Ministers of Environment (CCME Plant/Invert)
 4a. ORNL Benchmark (Efroymson, 1997a) Oak Ridge National Laboratory Plant Toxicological Benchmark (ORNL Plant)
 4b. ORNL Benchmark (Efroymson, 1997b) Oak Ridge National Laboratory Invertebrate Toxicological Benchmark (ORNL Invert)
- 5. Sunahara (Sunahara et al, 2009)
- 6. LANL (2012)

The benchmarks were selected by order of preference according to the following hierarchy:

	Chemical	Final Ecological	Source of
Chemical	Abstract Service	Screening	Final Ecological
	(CAS) No.	Level	Screening Level

^{7.} Target Value - Ministry of Housing, Spacial Planning and Environment

Screening Level Order of Preference for wildlife:

- 1. USEPA Eco SSL EPA Ecological Soil Screening Levels (EPA SSL Wildlife)
- 2. CCME Canadian Council and Ministers of Environment (CCME Wildlife)
- 3. LANL (2012)
- 4. USEPA Region 5 ESL EPA Region 5 Ecological Screening Levels (Region 5 ESL)

Abbreviations:

CCME - Canadian Council and Ministers of Environment

Eco SSL - Ecological Soil Screening Level

LANL - Los Alamos National Lab Ecorisk Database (Release 3.1)

NA = Not Available

ORNL - OakRidge National Laboratory

SSL - Soil Screening Level

USEPA = United States Environmental Protection Agency

References:

CCME, 1999. Canadian soil quality guidelines for the protection of environmental and human health. (Separate documents for each chemical).

Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997a. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-85/R3.

Los Alamos National Laboratory (LANL), 2012 (October). ECORISK Database (Release 3.1). LA-UR-12-24548. Los Alamos National Laboratory, Los Alamos, New Mexico.

MHSPE, 2000. Circular on target values and intervention values for soil remediation. Ministry of Housing, Spatial Planning and Environment. DBO/1999226863. Department of Soil Protection, The Netherlands. February 4.

Sunahara, G.I., G.R. Lotufo, R.G Kuperman, and J. Hawari, 2009. Ecotoxicology of Explosives. CRC Press, Taylor and Francis Group. 2009.

USEPA (U.S. Environmental Protection Agency), 2007. <u>Guidance for Developing Ecological Soil Screening Levels</u>. Office of Solid Waste and Emergency and Response. http://www.epa.gov/ecotox/ecossl/. (Separate documents for each chemical).

Chemical	Chemical Abstract Service (CAS) No.	Final Ecological Screening Level	Source of Final Ecological Screening Level
METALS (mg/kg)			-
ALUMINUM	7429-90-5	25500	NOAA
ANTIMONY ARSENIC	7440-36-0 7440-38-2	3 9.79	NOAA TEC
BARIUM	7440-38-2	48	NOAA
BERYLLIUM	7440-41-7	NA	NA NA
CADMIUM	7440-43-9	0.99	TEC
CALCIUM	7440-70-2	NA NA	NA NA
CHROMIUM	7440-47-3	43.4	TEC
COBALT	7440-48-4	50	LEL
COPPER	7440-50-8	31.6	TEC
IRON	7439-89-6	20000	LEL
LEAD	7439-92-1	35.8	TEC
MERCURY	7439-97-6	0.18	TEC
MAGNESIUM	7439-95-4	NA	NA
MANGANESE	7439-96-5	460	LEL
NICKEL	7440-02-0	22.7	TEC NA
POTASSIUM SELENIUM	7440-09-7 7782-49-2	NA 1	NOAA
SILVER	7440-22-4	0.5	LEL
SODIUM	7440-23-5	NA	NA NA
FHALLIUM	7440-28-0	NA NA	NA NA
/ANADIUM	7440-62-2	57	NOAA
ZINC	7440-66-6	121	TEC
TCL VOCs (MG/KG)		.=.	. = +
1,1,1-TRICHLOROETHANE	71-55-6	0.17	EPA SQB
1,1,2-TRICHLORO-1,2,2-TRIFLUORO-ETHANE	76-13-1	NA	NA
1,1,2,2- TETRACHLORETHANE	79-34-5	0.94	EPA SQB
1,1,2- TRICHLOROETHANE	79-00-5	1.2	SCV
1,1- DICHLOROETHANE	75-34-3	0.027	SCV
1,1-DICHLOROETHENE	75-35-4	0.031	SCV
1,2,3-TRICHLOROBENZENE	87-61-6	NA	NA
1,2,4-TRICHLOROBENZENE	120-82-1	9.2	EPA SQB
I,2-DIBROMO-3-CHLOROPROPANE	96-12-8	NA NA	NA NA
,2-DIBROMOETHANE	106-93-4	NA 0.34	NA FRA COR
,2- DICHLOROBENZENE ,2- DICHLOROETHANE	95-50-1 107-06-2	0.34 0.25	EPA SQB SCV
,2-DICHLOROPROPANE	78-87-5	0.23	ESV
,3-DICHLOROBENZENE	541-73-1	1.7	EPA SQB
1,4- DICHLOROBENZENE	106-46-7	0.35	EPA SQB
I,4-DIOXANE	123-91-1	0.119	ESV
2-BUTANONE	78-93-3	0.27	SCV
2-HEXANONE	591-78-6	0.022	SCV
4-METHYL-2-PENTANONE	108-10-1	0.033	SCV
ACETONE	67-64-1	0.0087	SCV
BENZENE	71-43-2	0.057	EPA SQB
BROMODICHLOROMETHANE	75-27-4	NA	NA
BROMOCHLOROMETHANE	74-97-5	NA 2.25	NA 2017
BROMOFORM	75-25-2	0.65	SCV
BROMOMETHANE	74-83-9 75-15-0	0.00137 0.00085	ESV SCV
CARBON DISULFIDE CARBON TETRACHLORIDE	56-23-5	1.2	EPA SQB
CHLOROBENZENE	108-90-7	0.82	EPA SQB
CHLOROETHANE	75-00-3	NA	NA
CHLOROFORM	67-66-3	0.022	SCV
CHLOROMETHANE	74-87-3	NA NA	NA NA
CIS-1,2- DICHLOROETHENE	156-59-2	0.4	SCV
CIS-1,3- DICHLOROPROPENE	10061-01-5	0.000051	SCV
CYCLOHEXANE	110-82-7	NA	NA
DIBROMOCHLOROMETHANE	124-48-1	NA	NA
DICHLORODIFLUOROMETHANE	75-71-8	NA	NA
THYLBENZENE	100-41-4	3.6	EPA SQB
SOPROPYLBENZENE	98-82-8	NA NA	NA NA
METHYL ACETATE	79-20-9	NA NA	NA NA
METHYLCYCLOHEXANE METHYLENE CHLORIDE	108-87-2 75-09-2	NA 0.37	NA SCV
METHYLENE CHLORIDE METHYL TERT-BUTYL ETHER	75-09-2 1634-04-4	0.37 NA	NA
STYRENE	100-42-5	0.254	ESV
ETRACHLOROETHENE	127-18-4	0.53	EPA SQB
OLUENE	108-88-3	0.67	EPA SQB
RANS-1,2- DICHLOROETHENE	156-60-5	0.4	SCV
RANS-1,3-DICHLOROPROPENE	10061-02-6	0.000051	SCV
RICHLOROETHENE	79-01-6	1.6	EPA SQB
RICHLOROFLUOROMETHANE	75-69-4	NA	NA
/INYL CHLORIDE	75-01-4	0.202	ESV
)-XYLENE	95-94-6	NA	NA
n,p-XYLENE	179601-23-1	NA	NA
CL SVOCs (MG/KG)			
,1'-BIPHENYL	92-52-4	1.1	EPA SQB
,2,4,5-TETRACHLOROBENZENE	95-94-3	1.252	ESV
2,2-OXYBIS(1-CHLOROPROPANE)	108-60-1	NA 0.120	NA FRV
2,3,4,6-TETRACHLOROPHENOL	58-90-2	0.129	ESV
,4,5-TRICHLOROPHENOL ,4,6-TRICHLOROPHENOL	95-95-4	0.003 0.006	NOAA NOAA
2,4-6-1 RICHLOROPHENOL	88-06-2 120-83-2	0.006	NOAA NOAA
2,4-DIMETHYLPHENOL	120-83-2	0.0002083	NOAA NOAA
2,4-DINITROPHENOL	51-28-5	0.016	ESV
,	121-14-2	0.00621	ESV

Observiced	Chemical	Final Ecological	Source of
Chemical	Abstract Service (CAS) No.	Screening Level	Final Ecological Screening Level
2,6-DINITROTOLUENE	606-20-2	0.0398	ESV
2-CHLORONAPHTHALENE	91-58-7	0.417	ESV
2-CHLOROPHENOL	95-57-8	0.000333	NOAA
2-METHYLNAPHTHALENE 2-METHYLPHENOL	91-57-6 95-48-7	0.021 0.008	NOAA NOAA
2-NITROANILINE	95-46-7 88-74-4	0.008 NA	NA NA
2-NITROPHENOL	88-75-5	NA NA	NA NA
3,3'-DICHLOROBENZIDINE	91-94-1	0.127	ESV
3-NITROANILINE	99-09-2	NA	NA
4,6-DINITRO-2-METHYLPHENOL	534-52-1	0.104	ESV
4-BROMOPHENYL-PHENYLETHER 4-CHLORO-3-METHYLPHENOL	101-55-3 59-50-7	1.3 0.388	EPA SQB ESV
4-CHLOROANILINE	106-47-8	0.146	ESV
4-CHLOROPHENYL-PHENYL ETHER	7005-72-3	NA	NA NA
4-METHYLPHENOL	106-44-5	0.1	NOAA
4-NITROANILINE	100-01-6	NA	NA
4-NITROPHENOL	100-02-7	0.0133	ESV
ACENAPHTHENE	83-32-9	0.016	EPA SQB
ACENAPHTHYLENE ANTHRACENE	208-96-8 120-12-7	0.00587 0.0572	NOAA TEC
ATRAZINE	1912-24-9	0.0372 NA	NA NA
BENZALDEHYDE	100-52-7	NA	NA NA
BENZO (A) ANTHRACENE	56-55-3	0.108	TEC
BENZO (A) PYRENE	50-32-8	0.15	TEC
BENZO (B) FLUOROANTHENE	205-99-2	0.13	NOAA
BENZO (G,H,I) PERYLENE	191-24-2	0.17	LEL
BENZO (K) FLUOROANTHENE BIS(2-CHLOROETHOXY) METHANE	207-08-9	0.24 NA	LEL NA
BIS-(2-CHLOROETHOXY) METHANE BIS-(2-CHLOROETHYL) ETHER	111-91-1	3.52	ESV
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	0.75	NOAA
BUTYLBENZYLPHTHALATE	85-68-7	11	EPA SQB
CAPROLACTAM	105-60-2	NA	NA
CARBAZOLE	86-74-8	NA	NA
CHRYSENE	218-01-9	0.166	TEC
DIBENZO (A,H)-ANTHRACENE	53-70-3	0.033	TEC
DIBENZOFURAN DIETHYLPHTHALATE	132-64-9 84-66-2	2 0.63	EPA SQB EPA SQB
DIMETHYLPHTHALATE	131-11-3	0.006	NOAA
DI-N-BUTYLPHTHALATE	84-74-2	11	EPA SQB
DI-N-OCTYLPHTHALATE	117-84-0	0.061	NOAA
FLUORANTHENE	206-44-0	0.423	TEC
FLUORENE	86-73-7	0.0774	TEC
HEXACHLOROBENZENE	118-74-1	0.02	NOAA
HEXACHLOROBUTADIENE	87-68-3	0.0013	NOAA
HEXACHLOROCYCLOPENTADIENE HEXACHLOROETHANE	77-47-4 67-72-1	0.901 1	ESV EPA SQB
INDENO (1,2,3-CD)-PYRENE	193-39-5	0.2	LEL
ISOPHORONE	78-59-1	0.432	ESV
NAPHTHALENE	91-20-3	0.176	TEC
NITROBENZENE	98-95-3	0.021	NOAA
N-NITROSO DIPHENYLAMINE	86-30-6	0.028	NOAA
N-NITROSO-DI-N PROPYLAMINE	621-64-7	NA 0.017	NA NOAA
PENTACHLOROPHENOL PHENANTHRENE	87-86-5 85-01-8	0.017	NOAA TEC
PHENOL	108-95-2	0.048	NOAA
PYRENE	129-00-0	0.195	TEC
EXPLOSIVES (MG/KG)			
1,3,5-TRINITROBENZENE	99-35-4	8	Sunahara
1,3-DINITROBENZENE	99-65-0	0.00861	ESV
2,4-DINITROTOLUENE 2,6-DINITROTOLUENE	121-14-2	0.29	LANL
NITROBENZENE	606-20-2 98-95-3	0.5 0.145	Sunahara ESV
2.4.6-TRINITROTOLUENE	118-96-7	4	Sunahara
2-AMINO-4,6-DINITROTOLUENE	35572-78-2	23	Sunahara
2-NITROTOLUENE	88-72-2	4.06	Region 3 (value for 4-nitrotoluene)
3-NITROTOLUENE	99-08-1	4.06	Region 3 (value for 4-nitrotoluene)
3,5-DINITROANILINE	618-87-1	NA NA	NA
4-AMINO-2,6-DINITROTOLUENE 4-NITROTOLUENE	1946-51-0 99-99-0	23	Sunahara (value for 2-amino-4,6-dinitrotoluene
HMX	99-99-0 2691-41-0	4.06 126	Region 3 Sunahara
TETRYL	479-45-8	0.1	Sunahara
RDX	121-82-4	102	Sunahara
PETN	78-11-5	NA NA	NA NA
NITROGLYCERIN	55-63-0	NA	NA
PCBs (MG/KG)	•		•
AROCLOR-1016	12674-11-2	0.0598	TEC
			TEC
AROCLOR-1221	11104-28-2	0.0598	
AROCLOR-1232	11141-16-5	0.0598	TEC
AROCLOR-1242	53469-21-9	0.0598	TEC
AROCLOR-1248	12672-29-6	0.0598	TEC
AROCLOR-1254	11097-69-1	0.0598	TEC
AROCLOR-1260	11096-82-5	0.0598	TEC
AROCLOR-1262	37324-23-5	0.023	EPA SQB

	Chemical	Final Ecological	Source of
Chemical	Abstract Service	Screening	Final Ecological
	(CAS) No.	Level	Screening Level
TCL Pesticides (MG/KG)			
4,4'-DDD	72-54-8	0.00488	TEC
4,4'-DDE	72-55-9	0.00316	TEC
4,4'-DDT	50-29-3	0.00416	TEC
ALDRIN	309-00-2	0.002	LEL
ALPHA-BHC	319-84-6	0.006	LEL
ALPHA-CHLORDANE	5103-71-9	0.00324	TEC
BETA-BHC	319-85-7	0.005	LEL
DELTA-BHC	319-86-8	0.12	SCV
DIELDRIN	60-57-1	0.0019	TEC
ENDOSULFAN I	959-98-8	0.0029	EPA SQB
ENDOSULFAN II	33213-65-9	0.014	EPA SQB
ENDOSULFAN SULFATE	1031-07-8	0.0346	ESV
ENDRIN	72-20-8	0.00222	TEC
ENDRIN ALDEHYDE	7421-93-4	0.48	ESV
ENDRIN KETONE	53494-70-5	NA	NA
GAMMA-BHC (LINDANE)	58-89-9	0.00237	TEC
GAMMA-CHLORDANE	5103-74-2	0.00324	TEC
HEPTACHLOR	76-44-8	0.01	NOAA
HEPTACHLOR EPOXIDE	1024-57-3	0.00247	TEC
METHOXYCHLOR	72-43-5	0.019	EPA SQB
TOXAPHENE	8001-35-2	0.028	EPA SQB

Sources Selected in the Following Order of Preference (excluding explosives): Abbreviations:

TEC (MacDonald, et al 2000) LEL (Persaud, et al 1993) EPA SQB (USEPA, 1996)

NOAA (Buchman, 2008) (freshwater value selected before marine value) SCV (Jones, et al 1997)

ESV (USEPA, 2003) LANL (LANL, 2012)

EPA -Environmental Protection Agency ESV - Ecological Screening Values LANL - Los Alamos National Laboratory

LEL - Lowest Effects Level NA - Not available

NOAA - National Oceanic and Atmospheric Administration

SCV - Secondary Chronic Values SQB - Sediment Quality Benchmarks

Sources for Explosives Selected in the Following Order of Preference: LANL (LANL, 2012) Sunahara (Suhahara, et al., 2009)

ESV (USEPA, 2003) NOAA (Buchman, 2008) Region 3 (USEPA, 2006)

References:

TEC - Threshold Effects Concentration

Buchman, M. F., 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration, 34 pages. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

Jones, D.S., R.N. Hull, and G.W. Suter II, 1997. <u>Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision.</u> Risk Assessment Program, Health Sciences Division, Oak Ridge, Tennessee. ES/ER/TM-95/R4. November.

Los Alamos National Laboratory (LANL), 2012 (October). ECORISK Database (Release 3.1). LA-UR-12-24548. Los Alamos National Laboratory, Los Alamos, New Mexico.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental Contamination and Toxicology, Vol. 39, pp. 20-31.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of Environment and Energy. August.

USEPA, 1996. ECO Update, Ecotox Thresholds. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Intermittent Bulletin, Volume 3, Number 2. EPA540/F-95/038. January.

USEPA, 2003. Ecological Screening Levels. USEPA Region 5 (http://www.epa.gov/reg5rcra/ca/edql.htm). August.

Sunahara, G.I., G.R. Lotufo, R.G Kuperman, and J. Hawari. 2009. Ecotoxicology of Explosives. CRC Press, Taylor and Francis Group. 2009.

USEPA, 2006. Region 3 Freshwater Sediment Screening Benchmarks. August.

http://www.epa.gov/reg3hv

fwsed/screenbench.htm

Chemical	Chemical Abstract Service (CAS) No.	Final Ecological Screening Level	Source of Final Ecological Screening Level
METALS (UG/L)	, ,		
ALUMINUM	7429-90-5	87	MEDEP
NTIMONY	7440-36-0	30	Region 3
RSENIC	7440-38-2	150	MEDEP
ARIUM	7440-39-3	4	Region 3
ERYLLIUM	7440-41-7	0.66	Region 3
ADMIUM	7440-43-9	0.08	MEDEP
CALCIUM	7440-70-2	116000	Region 3
HROMIUM	7440-47-3	23.1	MEDEP
CHROMIUM, hexavalent	18540-29-9	11	MEDEP
OBALT	7440-48-4	23	Region 3
OPPER	7440-50-8	2.36	MEDEP
RON	7439-89-6	1000	mEDEP
EAD	7439-92-1	0.41	MEDEP
MERCURY	7439-97-6	0.77	NRWQC ⁽¹⁾
MAGNESIUM	7439-95-4	82000	Region 3
MANGANESE	7439-96-5	120	Region 3
IICKEL	7440-02-0	13.4	MEDEP
OTASSIUM	7440-09-7	53000	Region 3
ELENIUM	7782-49-2	5	MEDEP
SILVER	7440-22-4	3.2	Region 3
ODIUM	7440-23-5	680000	Region 3
HALLIUM	7440-28-0	0.8	Region 3
'ANADIUM	7440-62-2	20	Region 3
INC	7440-66-6	30.6	MEDEP
CL VOCs (UG/L)		***	•
,1,1-TRICHLOROETHANE	71-55-6	11	Region 3
,1,2-TRICHLORO-1,2,2-TRIFLUORO-ETHANE	76-13-1		
,1,2,2-TRICHLORO-1,2,2-TRIFLOORO-ETHANE ,1,2,2-TETRACHLORETHANE	79-34-5	610	Region 3
,1,2- TRICHLOROETHANE	79-00-5	1200	Region 3
.1- DICHLOROETHANE	79-00-5	47	Region 3
,1-DICHLOROETHANE ,1-DICHLOROETHENE	75-34-3 75-35-4	25	Region 3
,1-DICHLOROE I HENE ,2,3-TRICHLOROBENZENE	75-35-4 87-61-6		Region 3 Region 3
		8	
,2,4-TRICHLOROBENZENE	120-82-1	24	Region 3
,2-DIBROMO-3-CHLOROPROPANE	96-12-8		
,2-DIBROMOETHANE	106-93-4		
,2- DICHLOROBENZENE	95-50-1	0.7	Region 3
,2- DICHLOROETHANE	107-06-2	100	Region 3
,2-DICHLOROPROPANE	78-87-5	5700	NOAA
,3-DICHLOROBENZENE	541-73-1	150	Region 3
,4- DICHLOROBENZENE	106-46-7	26	Region 3
,4-DIOXANE	123-91-1		
-BUTANONE	78-93-3	14000	Region 3
2-HEXANONE	591-78-6	99	Region 3
-METHYL-2-PENTANONE	108-10-1	170	Region 3
CETONE	67-64-1	1500	Region 3
ENZENE	71-43-2	370	Region 3
BROMODICHLOROMETHANE	75-27-4	1100	NOAA ⁽²⁾
ROMOCHLOROMETHANE	74-97-5		
ROMOFORM	75-25-2	320	Region 3
ROMOMETHANE	74-83-9		
CARBON DISULFIDE	75-15-0	0.92	Region 3
CARBON TETRACHLORIDE	56-23-5	13.3	Region 3
CHLOROBENZENE	108-90-7	1.3	Region 3
CHLOROETHANE	75-00-3		
CHLOROFORM	67-66-3	1.8	Region 3
CHLOROMETHANE	74-87-3	1.8	Region 3
CIS-1,2- DICHLOROETHENE		590	Region 3
	156-59-2		
IS-1,3- DICHLOROPROPENE	10061-01-5	0.055	Region 3
YCLOHEXANE	110-82-7		
DIBROMOCHLOROMETHANE	124-48-1	1100	NOAA ⁽²⁾
NICHLORODIFLUOROMETHANE	75-71-8	<u>-</u>	_ = -
THYLBENZENE	100-41-4	90	Region 3
SOPROPYLBENZENE	98-82-8	2.6	Region 3
METHYL ACETATE	79-20-9		
METHYLCYCLOHEXANE	108-87-2		
METHYLENE CHLORIDE	75-09-2	98.1	Region 3
METHYL TERT-BUTYL ETHER	1634-04-4	11070	Region 3
TYRENE	100-42-5	72	Region 3
ETRACHLOROETHENE	127-18-4	111	Region 3
OLUENE	108-88-3	2	Region 3
RANS-1,2- DICHLOROETHENE	156-60-5	970	Region 3
RANS-1,3-DICHLOROPROPENE	10061-02-6	0.055	Region 3
RICHLOROETHENE	79-01-6	21	Region 3
RICHLOROFLUOROMETHANE	75-69-4		Ĭ
INYL CHLORIDE	75-01-4	930	Region 3
-XYLENE	95-94-6	350	NOAA
n,p-XYLENE	179601-23-1	1.8	Region 3
OTAL XYLENES	,· ·	13	Region 3
CL SVOCs (UG/L)		10	rtogion o
1'-BIPHENYL	92-52-4	14	Region 3
,2,4,5-TETRACHLOROBENZENE	95-94-3	3	Region 3
			region 3
,2-OXYBIS(1-CHLOROPROPANE)	108-60-1		
,3,4,6-TETRACHLOROPHENOL	58-90-2	1.2	Region 3
,4,5-TRICHLOROPHENOL	95-95-4		
,4,6-TRICHLOROPHENOL	88-06-2	4.9	Region 3
,4-DICHLOROPHENOL	120-83-2	11	Region 3
,4-DIMETHYLPHENOL	105-67-9	100	NOAA

Chemical	Chemical Abstract Service (CAS) No.	Final Ecological Screening Level	Source of Final Ecological Screening Level	
2,4-DINITROPHENOL	51-28-5	19	NOAA	
2,4-DINITROTOLUENE	121-14-2	44	Region 3	
,6-DINITROTOLUENE	606-20-2	81	Region 3	
-CHLORONAPHTHALENE	91-58-7	0.396	NOAA	
-CHLOROPHENOL	95-57-8	24	Region 3	
-METHYLNAPHTHALENE -METHYLPHENOL	91-57-6 95-48-7	4.7 13	Region 3 Region 3	
-NITROANILINE	88-74-4		Region 3	
-NITROPHENOL	88-75-5	1920	Region 3	
3,3'-DICHLOROBENZIDINE	91-94-1	4.5	Region 3	
-NITROANILINE	99-09-2			
,6-DINITRO-2-METHYLPHENOL	534-52-1			
-BROMOPHENYL-PHENYLETHER	101-55-3	1.5	Region 3	
-CHLORO-3-METHYLPHENOL	59-50-7			
-CHLOROANILINE	106-47-8	232	Region 3	
-CHLOROPHENYL-PHENYL ETHER	7005-72-3			
I-METHYLPHENOL	106-44-5	543	Region 3	
-NITROANILINE	100-01-6			
-NITROPHENOL	100-02-7	60	Region 3	
CENAPHTHENE	83-32-9	5.8	Region 3	
CENAPHTHYLENE	208-96-8	4840	NOAA	
NTHRACENE	120-12-7	0.01	Region 3	
TRAZINE	1912-24-9	1.8	Region 3	
SENZALDEHYDE	100-52-7 56-55-3	0.01	 Region 3	
ENZO (A) ANTHRACENE ENZO (A) PYRENE	50-32-8	0.01	Region 3	
BENZO (A) PTRENE BENZO (B) FLUOROANTHENE	205-99-2	9.07	NOAA	
BENZO (G,H,I) PERYLENE	191-24-2	9.07	NOAA	
BENZO (K) FLUOROANTHENE	207-08-9	-		
BIS(2-CHLOROETHOXY) METHANE	111-91-1	1100	NOAA ⁽²⁾	
BIS-(2-CHLOROETHYL) ETHER	111-44-4	1900	NOAA	
BIS(2-ETHYLHEXYL) PHTHALATE	117-81-7	16	Region 3	
BUTYLBENZYLPHTHALATE	85-68-7	19	Region 3	
CAPROLACTAM	105-60-2			
CARBAZOLE	86-74-8			
CHRYSENE	218-01-9			
DIBENZO (A,H)-ANTHRACENE	53-70-3			
DIBENZOFURAN	132-64-9	3.7	Region 3	
DIETHYLPHTHALATE	84-66-2	210	Region 3	
DIMETHYLPHTHALATE	131-11-3	3	NOAA	
DI-N-BUTYLPHTHALATE	84-74-2	19	Region 3	
DI-N-OCTYLPHTHALATE	117-84-0	22	Region 3	
LUORANTHENE	206-44-0	0.04	Region 3	
LUORENE	86-73-7	3	Region 3	
HEXACHLOROBENZENE	118-74-1	0.0003	Region 3	
HEXACHLOROBUTADIENE	87-68-3	1.3	Region 3	
HEXACHLOROCYCLOPENTADIENE HEXACHLOROETHANE	77-47-4 67-72-1	0.053 12	NOAA Region 3	
NDENO (1.2.3-CD)-PYRENE	193-39-5	4.31	NOAA	
SOPHORONE	78-59-1	920	NOAA	
IAPHTHALENE	91-20-3	1.1	Region 3	
NITROBENZENE	98-95-3	220	NOAA	
I-NITROSO DIPHENYLAMINE	86-30-6	210	Region 3	
I-NITROSO-DI-N PROPYLAMINE	621-64-7			
PENTACHLOROPHENOL	87-86-5	6.69	MEDEP	
HENANTHRENE	85-01-8	0.4	Region 3	
PHENOL	108-95-2	4	Region 3	
YRENE	129-00-0	0.02	Region 3	
XPLOSIVES (UG/L)				
,3,5-TRINITROBENZENE	99-35-4			
,3-DINITROBENZENE	99-65-0		 D : 0	
,4-DINITROTOLUENE	121-14-2	44	Region 3	
,6-DINITROTOLUENE	606-20-2	81	Region 3	
ITROBENZENE ,4,6-TRINITROTOLUENE	98-95-3	220 100	NOAA Pagion 3	
-AMINO-4,6-DINITROTOLUENE	118-96-7 35572-78-2	1480	Region 3 Region 3	
-AMINO-4,6-DINITROTOLUENE -NITROTOLUENE	35572-78-2 88-72-2	1480	Region 3	
-NITROTOLUENE -NITROTOLUENE	99-08-1	750	Region 3	
,5-DINITROANILINE	618-87-1			
-AMINO-2,6-DINITROTOLUENE	1946-51-0	-		
-NITROTOLUENE	99-99-0	1900	Region 3	
IMX	2691-41-0	150	Region 3	
ETRYL	479-45-8			
DX	121-82-4	360	Region 3	
ETN	78-11-5	85000	Region 3	
ITROGLYCERIN	55-63-0	138	Region 3	
ERCHLORATE	14797-73-0	9,300	Dean	
	14131-13-0	0,000	Doan	
PCBs (UG/L)			(0)	
ROCLOR-1016	12674-11-2	0.014	MEDEP ⁽³⁾	
ROCLOR-1221	11104-28-2	0.014	MEDEP ⁽³⁾	
ROCLOR-1232	11141-16-5	0.014	MEDEP ⁽³⁾	
	1		MEDEP ⁽³⁾	
ROCLOR-1242	53469-21-9	0.014		
AROCLOR-1248	12672-29-6	0.014	MEDEP ⁽³⁾	
ROCLOR-1254	11097-69-1	0.014	MEDEP ⁽³⁾	
		0.014	MEDEP ⁽³⁾	

Chemical	Chemical Abstract Service (CAS) No.	Final Ecological Screening Level	Source of Final Ecological Screening Level
AROCLOR-1262	37324-23-5	0.014	MEDEP ⁽³⁾
AROCLOR-1268	11100-14-4	0.014	MEDEP ⁽³⁾
TCL Pesticides (UG/L)			
4,4'-DDD	72-54-8	0.01	Region 3
4,4'-DDE	72-55-9	105	NOAA
4,4'-DDT	50-29-3	0.001	MEDEP
ALDRIN	309-00-2	3	Region 3
ALPHA-BHC	319-84-6	10	NOAA
ALPHA-CHLORDANE	5103-71-9	0.0043	MEDEP
BETA-BHC	319-85-7	10	NOAA
DELTA-BHC	319-86-8	141	Region 3
DIELDRIN	60-57-1	0.056	MEDEP
ENDOSULFAN I	959-98-8	0.056	MEDEP
ENDOSULFAN II	33213-65-9	0.056	MEDEP
ENDOSULFAN SULFATE	1031-07-8	2.22	NOAA
ENDRIN	72-20-8	0.036	MEDEP
ENDRIN ALDEHYDE	7421-93-4	0.15	NOAA
ENDRIN KETONE	53494-70-5		
GAMMA-BHC (LINDANE)	58-89-9	0.01	Region 3
GAMMA-CHLORDANE	5103-74-2	0.0043	MEDEP
HEPTACHLOR	76-44-8	0.0038	MEDEP
HEPTACHLOR EPOXIDE	1024-57-3	0.0038	MEDEP
METHOXYCHLOR	72-43-5	0.03	MEDEP
TOXAPHENE	8001-35-2	0.0002	MEDEP

Sources Selected in the Following Order of Preference:

MEDEP - Maine DEP surface water quality criteria (MEDEP, 2012)
NRWQC - USEPA National Recommended Water Quality Criteria, chronic freshwater values (USEPA, 2013)

Region 3 - USEPA Region 3 Freshwater Screening Benchmarks (USEPA, July 2006)

NOAA - NOAA Screening Quick Reference Tables for freshwater surface waters (Buchman, 2008)

Abbreviations:

EPA -Environmental Protection Agency

NOAA - National Oceanic and Atmospheric Administration

Footnotes:

- 1 Lower value than MEDEP value of 0.91 ug/L. MEDEP regulations note that statewide criteria must not exceed federal water quality criteria.
- 2 Chronic value derived by divison of acute value by 10.
- 3 Value for total PCBs.

Buchman, M. F., 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration, 34 pages. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

MEDEP (Maine Department of Environmental Protection), 2012. Surface Water Quality Criteria for Toxic Pollutants. Chapter 584. Effective July

USEPA, 2006. Region 3 Freshwater Surface Water Screening Benchmarks. July.

http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fw/screenbench.htm USEPA, 2013. National Recommended Water Quality Criteria: 2013. Office of Water. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

APPENDIX C

TECHNICAL MEMORANDUM GROUNDWATER REPORT

TECHNICAL MEMORANDUM GROUNDWATER REPORT QUARRY AREA FORMER NAVAL AIR STATION BRUNSWICK, MAINE

INTRODUCTION

This Technical Memorandum documents and evaluates the groundwater investigation for the Quarry Area located at the former Naval Air Station (NAS) Brunswick in Brunswick, Maine. The 2012 groundwater investigation with 2013 follow-on work was performed by Tetra Tech, Inc., on behalf of the United States Navy, Contract Task Order (CTO) 69, under Contract Number N62472-03-D-0057 and CTO WE09 under Contract Number N62470-08-D-1001, as part of the Comprehensive Long-Term Environmental Action Navy (CLEAN) Environmental Restoration Program (ERP).

The first phase of groundwater investigation was performed from August through October 2012 in accordance with the Quarry Area Groundwater Investigation Work Plan (Tetra Tech, 2012a) and was expedited to advance property transfer of land adjacent to the site; an expanded investigation of other site media, including soil, surface water, and sediment, is pending in 2014. Monitoring wells were installed and sampled based on a bedrock fracture trace analysis; wells were installed where groundwater contamination was likely to be present if one or more releases had occurred. Quarry Area groundwater investigation activities were intended to be generally consistent with the Site 12 Explosive Ordnance Disposal (EOD) Area groundwater investigation because of similarities between the two sites; therefore, to streamline the investigation planning process, the Site 12 Sampling and Analysis Plan (SAP) (Tetra Tech, 2012b) was referred to in the work pan methodology information. A draft Quarry Area Technical Memorandum Groundwater Report (Tetra Tech, 2012c) was submitted in November 2012 to present the results of the 2012 effort, including the Bedrock Fracture Trace Analysis Report (Tetra Tech, 2012d), and to identify data gaps concerning the complex lithology and hydrogeology and extent of groundwater contamination at the site. Based on the groundwater elevation contouring and evaluation of groundwater results, additional monitoring wells were recommended to improve the understanding of shallow groundwater flow directions, confirm the analytical results of the 2012 groundwater sampling event, and further characterize groundwater conditions at the Quarry. The 2013 follow-on investigation was conducted in accordance with the Quarry Area Groundwater Work Plan Tech Memo Addendum (Tetra Tech, 2013), and field work was performed from November through December 2013.

The primary objective of the 2012/2013 groundwater investigation was to determine if groundwater quality in the Quarry Area has been impacted by historical disposal of construction debris and possibly hazardous waste and munitions items, as well as land-farming and munitions-related detonation activities. Therefore, the groundwater investigation assessed potential chemical contamination associated with munitions constituents (MC) and petroleum- and non-petroleum-related constituents. The area

associated with borrow pits is unknown; all that is available is a drawing from 1958 showing the borrow pit boundary at that time. The depth of the borrow pit appears to be below the water table and so groundwater may have been impacted by direct contact with contaminant sources or via leaching of contaminants from soil to groundwater. Therefore, groundwater samples were analyzed for a full analytical suite of both MC and non-munitions-related waste constituents, measured in the surficial aquifer at locations of greatest potential for contamination, such as groundwater underlying the landfilling and land-farming area and the site perimeter. The first occurrence of groundwater in the central Quarry Area was assumed to have the greatest potential to be contaminated. The primary objective was to support determination of the extent of contamination. Secondary objectives were to expand the understanding of shallow groundwater flow directions in the Quarry Area and to support conditions of property transfer regarding groundwater use.

BACKGROUND

The Quarry Area site is located near the southwestern end of the runways at former NAS Brunswick, as shown on Figure 1, and adjacent to Maine State Route 123 (Harpswell Road). The site originally comprised approximately 4 acres but, based on step-out finding of munitions items, the investigation boundary has expanded to at least 12 acres to date and includes areas south and east of the original site boundary. A final phase of munitions and explosives of concern (MEC) investigation is underway to complete the determination of the site boundary. A 20- to 30-foot rock face is present at the eastern end of the site, resulting from rock guarrying activities took place from the 1940s through the 1950s. To the west, an access road runs uphill to a radar tower. From 1992 to 1995, land spreading of fuelcontaminated soil originating from other areas of NAS Brunswick was conducted in the eastern portion of the Quarry Area. In 1992, 350 to 450 cubic yards of fuel-contaminated soil were brought to the Quarry, spread to a depth of 6 to 10 inches directly on top of existing soil, and then fertilized to promote bioremediation. Similar operations occurred again in 1993 and 1995. These land-spreading events were conducted in accordance with guidelines provided by Maine Department of Environmental Protection (MEDEP) to remediate the soil. Currently, a dirt road transects the Quarry Area and ends at a location where nearby indications of soil disturbance are evident (i.e., the eastern portion of the site that was used for land spreading). Man-made disturbances are also present throughout the southern end of the Quarry Area. A significant amount of debris, including scrap metal, tires, and concrete, is located along the rock face at the eastern end of the Quarry Area at the ground surface and partially buried, suggesting that the Quarry Area was additionally used for landfilling purposes.

The Preliminary Assessment (PA) (Malcolm Pirnie, 2007) mentioned an "undocumented report" that the Quarry Area may have been used for past EOD activities but noted that no written record of this report was found during the PA process. More specifically, the earlier 1991 Draft Final Supplemental Remedial Investigation (RI) Report (E.C. Jordan, 1991) states that during a site visit and interview, it was indicated that undocumented reports exist of past EOD activities in a rock quarry located southwest of runways at

the NAS Brunswick boundary, where the boundary is adjacent to Maine State Route 123. Since then, Tetra Tech completed an MEC Site Inspection (SI) at the Quarry Area (Tetra Tech, 2009) that included both a detector-aided surface survey and digital geophysics practicing unexploded ordnance (UXO) avoidance. During the MEC SI detector-aided surface survey, one material potentially presenting an explosive hazard (MPPEH) item was discovered on the ground surface in the south-central area of the site, warranting an expanded investigation of the ground surface and an intrusive investigation of the subsurface targeting anomaly locations identified during the MEC SI. This field work was conducted by Tetra Tech in 2010 as the Exploratory MEC Investigation (Tetra Tech, 2011). Subsurface MPPEH was encountered; moreover, opportunity soil sampling of select constituents conducted during the 2010 intrusive Exploratory MEC Investigation indicated the presence of low-level contamination of various analytes. Subsequently, a MEC Time-Critical Removal Action (TCRA) was conducted by Tetra Tech in 2011 and expanded upon in 2012 during which MEC/MPPEH items were encountered at the ground surface and in the shallow subsurface and removed. A chain-link fence surrounds the brush-covered Quarry floor area where waste disposal occurred, as depicted on Figure 2. Based on the undetermined extent of MEC/MPPEH remaining, a final step-out investigation for MEC/MPPEH is underway to remove any munitions items that may be present.

Surface water runoff from the Quarry Area follows topography to the west toward a culvert that crosses Maine State Route 123 and flows south across old Route 24. Surface water also appears seasonally in a small depression near the southeastern corner of the quarried area, as depicted on Figure 2.

FIELD INVESTIGATION PROGRAM

The combined 2012 and 2013 scope of work for this investigation included the following:

- Clearances for utilities and UXO avoidance.
- Radiation monitoring (see discussion in next section).
- Advancement of 13 soil borings at proposed monitoring locations, including screening of soil with a photoionization detector (PID).
- Coring of bedrock.
- Installation, development, and sampling of monitoring wells.
- Installation of staff gauges in ponded seasonal water bodies.
- Surveying of the locations and elevations of 13 monitoring wells and three staff gauges.
- Collection of four rounds of synoptic groundwater and surface water level data.

The locations of the monitoring wells and staff gauges, along with the MEC/MPPEH location findings through 2012, are shown on Figure 3.

Utility Clearance/UXO Avoidance/Radiation Monitoring

Utility clearance efforts, designed to clear proposed investigation locations of underground utilities, consisted of a notification to the State of Maine's Dig Safe system, coordination with the Navy Caretaker's Office, and procurement of a utility-locating service to evaluate potential underground utilities in the vicinity of the site. These utility clearance activities were undertaken prior to initiation of the 2012 and 2013 investigation tasks at the Quarry Area. Proposed soil boring/monitoring well locations were marked (and adjusted as warranted) in the field after the Dig Safe process, were reviewed by the Caretaker's Office, and the subsurface utility locate program completed.

Munitions items were expected in certain subsurface areas of the Quarry; therefore, an explosive hazard/risk was assumed to exist. In addition, this site has been identified as an area where low levels of radionuclides may be present due to former disposal practices. Therefore, UXO specialists and radiation technicians provided monitoring services to support health and safety requirements necessary to complete this field effort.

Each soil bring location was screened by a qualified UXO Technician for anomalies potentially representing munitions items to pre-clear drilling locations. Initially, a Schonstedt® magnetometer was used to screen the ground surface for metal, and as each soil boring was advanced, a down-hole magnetometer was placed in each borehole to continue screening with depth. Magnetometer readings indicating potential buried metal were measured only during advancement of the soil boring associated with monitoring well MW-QRY-12, located within the known borrow pit area as illustrated by the 1958 map. The drilling location was moved nearby three times, and the boring was completed during the fourth attempt at a location with no indications of buried metal.

Also, for those wells within the disposal area, where the potential for radiological waste exists, soil boring locations were screened by a Health Physicist for radiation. A Ludlum® Model 19 Nal scintillation detector was used to screen the ground surface for radiation levels, where applicable, and during drilling operations, smear/wipe samples were collected from down-hole drilling tools and analyzed for radiation levels with a Ludlum® Model 2360 scaler/ratemeter coupled with a Ludlum® Model 43-93 alpha/beta probe and Ludlum® Model 2929 scaler. All radiation measurements were consistent with normally distributed background levels.

Soil Sampling/Rock Coring

Thirteen soil borings were advanced during the Quarry Area investigation and subsequently converted to permanent monitoring wells, as presented on Figure 3. Of the 13 soil borings, nine borings (MW-QRY-01A, -01B, -02, -04 through 08, and -12) were also cored into bedrock. Soil sampling was performed at all but one location (SB-QRY-01B because it was paired with SB-QRY-01A) using a split-spoon sampler with drive and wash drilling techniques. Bedrock coring was conducted using HQ wireline coring

methods. As per the planning documents, if less than 3 feet of saturated thickness was present or if the overburden was tight (e.g., clay), soil borings/wells were completed in the upper fractured bedrock, with monitoring well screens installed to intersect shallow water-bearing fractures identified during bedrock coring activities. Otherwise, overburden wells were installed where the first water-bearing zone was encountered.

During the 2012 event, five soil borings/wells were installed, with four wells completed as bedrock monitoring wells (MW-QRY-01A, -01B, -02, and -04) and one completed as an overburden well (MW-QRY-03). Eight soil borings/rock corings were similarly advanced and converted to permanent monitoring wells during the 2013 event. Of these eight wells, five were completed as bedrock wells (MW-QRY-05, -06, -07, -08, and -12) and three completed as overburden wells (MW-QRY-09, -10, and -11). One contingency soil boring/monitoring well MW-QRY-13, proposed as a paired overburden well associated with and near bedrock well MW-QRY-07, was not advanced or installed because insufficient groundwater was encountered in the overburden during advancement of the boring for MW-QRY-07.

A summary of well completion data, boring logs, and well construction logs are provided in Table 1, Appendix A-1, and Appendix A-2, respectively.

The soil borings were advanced using an all-terrain vehicle (ATV) drill rig. At all locations except boring SB-QRY-01B, soil samples were collected during borehole advancement using a 24-inch-long, 3-inch-diameter steel, split-spoon sampler advanced with a 140-pound hammer dropped from 30 inches. Soil samples were not collected from SB-QRY-01B because it was located close to boring SB-QRY-01A. Following advancement of the split-spoon sampler to a depth of 4 feet below ground surface (bgs), a nominal 4-inch-diameter steel casing was advanced with a 300-pound hammer, and soil from within casing was then washed out using a tri-cone roller bit with circulating water. Following collection, each soil sample was screened for organic vapors, the lithology of the soil was determined, and the results were recorded on a boring log. Boring logs are provided in Appendix A-1.

Soil cores were first screened for the presence of organic vapors using a PID and the jar headspace method. Results of jar headspace PID readings collected during this investigation were recorded on boring logs. Soil was screened with the PID every 6 inches above the water table and every 12 inches below the water table in the overburden. No significant PID responses, staining, or odors were observed during soil sampling activities; PID responses were all zero except for source area well MW-QRY-03, which had PID readings of 0.2 and 0.1 part per million (ppm) in 2012 and 2013, respectively. The soil samples were classified for lithology according to the Unified Soil Classification System (USCS).

Bedrock coring was performed at nine well locations (MW-QRY-01A, -01B, -02, -04 through 08, and -12 by initially seating the 4-inch-diameter steel casing into bedrock by driving it with the 300-pound hammer, sufficient to seal the overburden. HQ wireline methods with a 3-7/8-inch outer diameter diamond-impregnated drill bit were then used to advance the borehole into rock. Water was used as the

drilling fluid during coring. For each core run, typically 5 feet in length, the Tetra Tech field geologist noted the start and end times, amount of water lost, classification of rock types, calculated Rock Quality Designations (RQDs), and depths and occurrence of possible water-bearing fractures and joints. The coring information was recorded on soil boring logs, provided in Appendix A-1.

Well Installation/Development

The bedrock monitoring wells (MW-QRY-01A, -01B, -02, -04, -05, -06, -07, -08, and -12) were completed in shallow bedrock at depths ranging from 16 to 28 feet bgs, and the overburden wells (MW-QRY-03, -09, -10, and -11) were completed at depths ranging from 10.5 to 14 feet bgs. The wells were constructed of 2-inch inside diameter Schedule 40 polyvinyl chloride (PVC) casing, with the screen length dependent on the thickness of the target monitoring zone. The overburden wells had screen lengths that varied from 5 to 8 feet, and bedrock well screens were typically 10 feet in length, except one 5-foot screen (MW-QRY-01A) and one 8-foot screen (MW-QRY-4) based on site conditions at those locations. The well screens had slot openings of 0.010 inch. The bottom of each well was completed with a flush-threaded bottom plug. The annular space around the well screens were filled with by OS-grade silica sand (equivalent to 20 to 30 grade sand) to approximately 0.5 to 2 feet above the top of the well screen. A bentonite seal was installed above the sand filter to within several feet of the ground surface and hydrated in place, and a sand drainage layer was placed on top of the bentonite to approximately 0.5 foot bgs. The wells were completed at the surface with 5-foot steel casings and slip caps set in concrete.

Each well, except for MW-QRY-01A, was developed no sooner than 48 hours after well completion to remove any fine-grained material that may have been introduced into the well during advancement and completion efforts and to enhance the hydraulic connection between the sand pack and the surrounding native formation. Wells were developed using a submersible pump until turbidity levels reached 10 nephelometric turbidity units (NTUs), a minimum of three times the standing water volume in the well casing was removed, or until field parameters stabilized, whichever occurred first for a given well. Well development logs are provided in Appendix A-3.

During drilling in 2012 at the first well location (MW-QRY-01), numerous weathered, high-angle, foliation fractures and sub-horizontal joints were observed in the bedrock. In addition, iron staining was observed in the fractures, and approximately 200 gallons of water were lost to the formation during drilling. These factors suggested that groundwater was present in this zone, and a well was installed. However, the well was dry following installation, and despite attempts to develop the well by adding water and surging to open any fractures potentially blocked by fines, the well remained dry. The well was designated MW-QRY-01A, and a replacement well, MW-QRY-01B, was installed approximately 10 feet west of and approximately 10 feet deeper that intersected the water table. Well MW-QRY-01A was retained pending determination of potential future use of the well. During the 2013 sampling event, groundwater was present in well MW-QRY-01A, and groundwater from the well was sampled for laboratory analyses. Well

MW-QRY-01A was not developed prior to purging and sampling due to concerns about poor recovery and whether sufficient groundwater would be available for sampling if the well was developed. This is not considered to be a concern for the representativeness or usability of the groundwater data collected from well MW-QRY-01A. The water level observed in the well was consistent with the water level observed in well MW-QRY-01B, and the groundwater purged prior to sampling was clear and had a low turbidity throughout purging. The water levels observed in well MW-QRY-01A are discussed further in the Geology/Hydrogeology section.

Groundwater Sampling

Groundwater samples were collected from four monitoring wells (MW-QRY-01B, -02, -03, and -04) on August 28 and 29 during the 2012 event. On December 2 through 3, 2013, these wells were sampled again along with the previously dry well (MW-QRY-01A) and the eight newly installed monitoring wells (MW-QRY-05 through -12).

During the 2012 event, groundwater samples were not collected until 4 to 6 days after development of the monitoring wells, and during the 2013 event, groundwater samples were not collected until more than 2 weeks after development of the 2013-installed wells. The groundwater samples were collected in accordance with United States Environmental Protection Agency (EPA) low-flow purging and sampling procedures. Non-dedicated submersible bladder pumps were used for groundwater purging and sampling efforts. Pumps were decontaminated between each well, in accordance with the work plan, and dedicated tubing was used at each monitoring well to minimize the potential for cross contamination between sampling locations.

During purging, groundwater was pumped through a flow-through cell equipped with an YSI 650 water quality instrument for the measurement of pH, conductivity, temperature, dissolved oxygen (DO), and oxidation-reduction potential (ORP) data. Water level drawdown and flow rates were recorded on groundwater sample log sheets during purging, as documented in Appendix A-4. The water quality instrument was calibrated according to the manufacturer's specifications and Tetra Tech's Standard Operating Procedure (SOP) GW-0001. Ideally, each well was purged until the turbidity level was less than 10 NTUs before sampling, as measured with a nephelometer. If turbidity, and other field data stability criteria, were not met after 2 hours of purging, groundwater samples were collected for laboratory analysis, and the final collected measurements were noted on the purge data sheet. Final water quality measurements during purging are summarized in Table 2. Well purge data sheets and groundwater sample logs are provided in Appendix A-4.

For both the 2012 and 2013 events, groundwater samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), ethylene dibromide (EDB), semivolatile organic compounds (SVOCs), explosives plus nitroglycerine, Target Analyte List (TAL) metals, pesticides, polychlorinated biphenyls (PCBs), volatile petroleum hydrocarbons (VPH), extractable petroleum hydrocarbons (EPH),

and perchlorate. The analyses were performed using MEDEP- and EPA-approved methods, except VPH and EPH analyses, which were performed following Massachusetts Department of Environmental Protection (MADEP) guidelines. A summary of chemical analysis conducted for the 2012 and 2013 sampling events is provided in Table 3, and a summary of quality control (QC) samples is provided in Table 4. The complete validated analytical results (detected and non-detected analytes) are included in Appendix B-2.

Groundwater samples for all analyses except perchlorate were submitted to Katahdin Analytical Services in Scarborough, Maine, for analysis. For perchlorate, samples were sent to Test America in South Burlington, Vermont, for the 2012 event and to Microbac Laboratories, Inc., Marietta, Ohio for the 2013 event. Chain-of-custody forms are provided as Appendix B-1.

Staff Gauge Installation

Three staff gauges were installed at the Quarry Area to provide water level information at several surface water locations (Figure 2 and 3) for incorporation into the potentiometric mapping of groundwater. Two staff gauges, SG-QRY-01 and SG-QRY-02, were installed at the Quarry Area on August 23, 2012. SG-QRY-01 was installed in an area of standing water located in the southeastern corner of the Quarry, and SG-QRY-02 was installed in the western portion of the Quarry Area, west of the culvert that crosses Harpswell Road. SG-QRY-03 was installed on October 12, 2012, in standing water south of the site perimeter road, as depicted on Figures 2 and 3, to address a data gap in preparing the groundwater potentiometric surface map in development at the time. A 5-pound sledge hammer was used to drive the staff gauge posts through the underlying sediment. Water level elevations for the staff gauges are provided in Table 1.

Slug Tests

In-situ hydraulic conductivity testing (slug tests) was completed to collect hydraulic conductivity data at a select number of representative monitoring wells following installation, development, and sampling. Testing was performed in three overburden wells (MW-QRY-03, -09, and -10) and four bedrock wells (MW-QRY-01B, -02, -07, and -12).selected based on spatial distribution and lithological or hydrogeological differences and in consultation with MEDEP and USEPA. Results are summarized in Table 5.

The slug tests were performed using a solid PVC slug, with changes in head measured using a pressure transducer. Rising-head tests were conducted in all of the wells tested, and if the static groundwater level was measured above the screened interval, a falling-head test was also completed. The slug tests data were analyzed using the Bouwer and Rice method (Bouwer, 1989). Appendix A-5 includes the slug test data and calculations. Results of the tests are discussed in the Geology/Hydrogeology section.

Surveying

The locations and elevations of the monitoring wells and staff gauges at the Quarry Area were surveyed by a State of Maine licensed land surveyor. For the 2012 event, Brian Smith Surveying of Bowdoinham, Maine, surveyed the initial five new wells and three staff gauges. For the 2013 event, Spivey Surveying Services of Brunswick, Maine, surveyed the eight new monitoring wells installed. Horizontal controls, to the nearest 0.01 foot at each data point, were established relative to the North American Datum of 1983 (NAD83), Maine State Plane Coordinate System West Zone. Vertical controls to the nearest 0.01 foot were established relative to the National American Vertical Datum (NAVD) of 1988. Elevations were measured at the ground surface, top of well casing, and top of the protective casing at each well. The measuring points (3-foot marks) were measured as reference points for the staff gauges. Survey data for the wells and staff gauges are provided in Table 1. The complete survey data are included in Appendix B-3.

Water Level Gauging

Four rounds of synoptic groundwater and surface water level measurements were collected during this combined investigation. In 2012, each monitoring well and staff gauge (except SG-QRY-03) was gauged on August 28, and an additional gauging event took place on October 12 to incorporate newly installed staff gauge SG-QRY-03. In 2013, water levels were measured on October 28, prior to installing the new monitoring wells, to determine whether drilling the proposed wells would affects water levels in existing wells, and then on December 2 prior to groundwater sampling.

Depths to groundwater and surface water and corresponding elevations for all four rounds are summarized in Table 1. Groundwater/surface water level measurement sheets are provided in Appendix A-6.

Investigation-Derived Waste

Investigation-derived waste (IDW) generated during this investigation included soil, groundwater, and decontamination liquids. The IDW were containerized by medium and staged at the Quarry Area pending full characterization for subsequent disposal by a qualified subcontractor.

GEOLOGY/HYDROGEOLOGY RESULTS

This section presents the geologic and hydrogeologic interpretations from the 2012 and 2013 Quarry Area groundwater field investigation.

Geology

The geology of the Quarry Area varies across the site for both unconsolidated materials and bedrock. These findings are consistent with the history of the site, which included extensive mining of the bedrock,

development of the access road for the radar tower, disposal of construction debris, and land-spreading activities which disposed of several feet of fill material from elsewhere on Base into the central quarry area. Soil in the area is the Windsor-Hinckley-Deerfield Association, which is characterized as deep, excessively to moderately well-drained, nearly level to steep, coarse-textured soil. Within the former quarry, a thin veneer of unconsolidated material is present overlying bedrock. West of the former quarry, the bedrock surface dips to the west, and unconsolidated material is encountered to approximately 30 feet. East of the former quarry, clay and silt is encountered within the bedrock valley, with bedrock dipping to the northeast.

Three geologic cross sections (A-A', B-B', and C-C') were generated using data collected during this investigation and the Bedrock Fracture Trace Analysis (Tetra Tech, 2012d). A bedrock surface map is presented as Figure 4. The cross section locations are presented on Figure 5, and the individual cross sections are presented on Figures 6 through 8. Boring logs from this investigation are provided in Appendix A-1.

Surface materials within the former quarried area (at MW-QRY-04, -05, and -12) consist of up to 6 inches of topsoil and 1.5 to 6 feet of reworked soil material consisting of varying quantities of fine to medium sand, silt, and gravel, with minor amounts of debris (e.g., copper wire at MW-QRY-04 and brick at MW-QRY-12) and wood. Underlying the overburden within the former quarry is bedrock of the Cushing Formation. The bedrock in the northern portion of the quarry (MW-QRY-05) is gray granofels (biotite, feldspar, quartz, and garnet), and bedrock in the southern portion (MW-QRY-04 and 12) is grayish green amphibolite (hornblende and feldspar with some quartz veins and garnet). Both rock types were observed to have steeply dipping foliation and fracturing along foliation as well as sub-horizontal fracturing.

The areas south and east of the quarried area (at MW-01A, -01B, -02, -06, -07, and -08) have surface materials of topsoil underlain by reworked material, sand, and/or clay. In the area to the south along Old Route 24 (MW-QRY-02 and MW-QRY-06), reworked material of sand with varying amounts of silt and gravel was present below topsoil underlain by sand (interpreted as Upper Sand unit) to the top of bedrock. Bedrock was encountered at 7 and 4 feet bgs, respectively at these locations. The area southeast and east of the quarry (MW-QRY-01A, -01B, and -07) has clay (interpreted as the Presumpscot Clay) draping onto the bedrock surface. At location MW-QRY-01A, reworked material of sand, silt, and gravel was observed on top of the clay to approximately 5 feet bgs. Till was observed overlying bedrock at this location from 10.6 to 11.9 feet bgs. At location MW-QRY-07, 1.5 feet of silt was present at the surface, and clay with silt was present to the top of bedrock at 11.3 feet bgs. Location MW-QRY-08, the easternmost location in the investigation, had a thin mantle of sand and silt to the top of bedrock, which occurred at 4.3 feet bgs. The bedrock in the area south of the former quarry (MW-QRY-01A, -01B, -02, and -06) was greenish gray amphibolite, and bedrock in the eastern area (MW-QRY-07 and MW-QRY-08) was gray granofels. A cream-colored pegmatite (coarse-grained feldspar and quartz) was encountered at

18.2 feet bgs at MW-QRY-01A and 24 feet bgs at MW-QRY-01B. Foliation and fracturing were similar in these areas to within the former quarry area.

In the areas southwest, west, and northwest of the former quarry (MW-QRY-03, -09, -10, and -11), overburden materials were encountered to depths ranging from 14.5 to 33.5 feet bgs. The surface material in these areas was sand (Upper Sand) to either the top of clay [west, southwest, and north (MW-QRY-03, -09, and -11, respectively)] or bedrock [north (MW-QRY-10)]. At location MW-QRY-03, which is identified as being within the former quarry, reworked sand and silt were present to 2 feet bgs, the clay unit (interpreted as the Presumpscot Clay) extended from north to southwest and was encountered between 10 and 11 feet bgs. The clay was approximately 30 feet thick and overlaid bedrock. A 1-foot thick layer of till was present at the bedrock surface at MW-QRY-09. At the northwestern location (MW-QRY-10), sand was present to approximately 9 feet bgs, with coarse sand, silt, and gravel from 9 feet to the top of bedrock at approximately 13.6 feet bgs.

Both low- and high-angle fractures were observed in the bedrock of the Quarry Area during a November 2011 site visit and during the fracture trace analysis performed on July 9 and 10, 2012. Jointing and fracturing identified in the bedrock cores were primarily foliation plane fractures and sub-horizontal joints near the surface of the bedrock. Foliation planes in the amphibolite were measured at 70 degrees, which is consistent with the distribution of foliation plane measurements in Bedrock Fracture Trace Analysis Report (Tetra Tech, 2012d). Vertical joints were noted at MW-QRY-01B within the pegmatite at 18 feet bgs and within the Cushing Formation at MW-QRY-02 at 15 feet bgs and 19 to 22 feet bgs and at MW-QRY-04 at 8 feet bgs. Iron staining, mud-infilling, and weathering were common in fractures within cores, indicating water movement through fractures. The integrity of the rock was good to excellent, with RQDs calculated from core recoveries typically between 72 and 100 percent. The rock brokenness in the cores was typically broken, with zones of very broken to massive in several locations. Descriptions and locations of fractures and joints were recorded on boring logs included in Attachment A-1.

The Quarry Area is located on the northwestern side of a north-northeast-oriented bedrock ridge identified in the photo-lineament analysis conducted as part of the Bedrock Fracture Trace Analysis (Tetra Tech, 2012d). The ridge is visible on the 2011 Brunswick 7.5-minute United States Geological Survey (USGS) quadrangle, provided in Appendix A-7. The 1958 historical topographic map, which provides a snapshot of former quarry activities, is provided in Appendix A-8. Rock quarrying activities that took place at the site from the 1940s through the 1950s significantly altered the surface topography in the Quarry Area. The quarrying activities are evident in the variable topography shown on cross sections A-A' and C-C', which depict the steep bedrock quarry walls and the 1958 extent of the quarry borrow pit. The surface of the top of bedrock, as interpreted from the data from this investigation, is presented on Figure 4.

Reworked material [fine to medium sand, silt, and gravel, with minor amounts of debris (e.g., copper wire at MW-QRY-04 and brick at MW-QRY-12) and wood] is present across the central portion of the site. In

the 1958 topographic map, the quarry borrow pit was approximately 6 feet bgs in the central portion of the quarry, which is generally consistent with the depth to bedrock at MW-QRY-04 and MW-QRY-05 and the thickness of reworked material depicted on the cross sections within the quarry boundaries. The reworked material may be related to the completion of the radar tower access road, regrading of the site following the completion of the quarrying, and/or land-farming activities that may have deposited up to 1 to 2 feet of soil in the central portions of the site. During quarrying, unconsolidated overburden material was likely removed to access the underlying bedrock and may have been spread to the south on the outer slopes of the quarry between the quarry rim and Old Route 24. In addition, reworked material was likely graded to the west toward the radar tower access road and subsequently reworked to build the access road, which was completed after quarrying activities ended. The bedrock surface dips to the west in the western portion of the site, where the depth to bedrock increases from 6.5 feet bgs at MW-QRY-04 to 31 feet bgs at MW-QRY-03, and the bedrock surface dips to the north in the valley east of the former quarry.

Hydrology/Hydrogeology

Surface water at the site follows topography, with drainage pathways to the south from the southern quarry wall (MW-QRY-02 toward the topographic low near staff gauge SG-QRY-03). Surface water also drains to the east from the top of the eastern quarry wall. In the central portion of the site (north of MW-QRY-04), surface water is slow to drain due to the generally flat topography but tends to drain to the east toward the base of the eastern quarry wall. In the western portion of the site near MW-QRY-03, surface water drains to the west and south.

Groundwater elevations from four measurement events in 2012 and 2013 are provided in Table 1, and groundwater potentiometric surface contours as measured on October 12, 2012, and December 2, 2013, are provided on Figures 2 and 3, respectively.

Groundwater is unconfined in the Quarry Area, with exception of the area of the eastern area of the site (MW-QRY-07). Within the former limits of the quarry and along the southern and eastern limits of the investigation, groundwater is present in the bedrock. In the western portions of the investigation area, groundwater occurs in the overburden sand (Upper Sand), above the clay unit (MW-QRY-03, -09, and -11), or in bedrock (MW-QRY-10). In the area of MW-QRY-07, groundwater is under confined conditions due to the presence of low -permeability silts and clay to a depth of 13 feet bgs. Although MW-QRY-07 was screened in bedrock at 17 to 27 feet bgs, the groundwater head elevation compared to approximately 1 foot bgs.

Groundwater head elevations were higher in December 2013 than in August 2012. The December 2013 head elevations were between 1 to 7 feet higher in the 2012-installed monitoring wells (MW-QRY-01 through -04), which may be related to seasonal conditions (i.e., late summer being drier compared to early winter being wetter). The higher water table in December 2013 intersected the screen in well

MW-QRY-01A, whereas the well was dry in August 2012. The elevations of the surface water locations did not differ significantly between August 2012 and December 2013, except for SG-QRY-01. At SG-QRY-01, the water level was 2.5 feet higher in December 2013.

Groundwater flow at the Quarry Area is to the northwest west of the Quarry wall and to the northeast east of the Quarry wall, as depicted on Figure 3. Groundwater generally follows topography in the Quarry Area. Based on head elevations measured on December 2, 2013 (which provide more data points than August 2012), a groundwater divide is present along the bedrock ridge that trends northeast-southwest through the site. Groundwater flow is to the northeast, transitioning from unconfined conditions near the ridge south of the quarry (MW-QRY-01A and -01B) and along the topographic high across the valley (MW-QRY-08) to confined conditions in the northeast (MW-QRY-07) due to the low-permeability units overlying bedrock in that area. East of the bedrock ridge, groundwater is present in the bedrock and transitions to the overburden as the bedrock surface dips in the vicinity of MW-QRY-03. The head elevations are consistent between the bedrock and overburden units, confirming the transition. The hydraulic gradient in the shallow bedrock within the former quarry is 0.010, and the hydraulic gradient in the overburden, as measured in the northwestern portion of the site, is 0.027.

Bulk hydraulic conductivity values for the overburden and shallow bedrock zones are provided in Table 5. The mean hydraulic conductivity value for the overburden (Upper Sand) was 3.65 feet per day, and the mean value for the shallow bedrock was 11.8 feet per day. The values for the overburden ranged from 0.61 to 12.5 feet per day, and the values for the shallow bedrock ranged from 0.68 to 47.6 feet per day. The hydraulic conductivity values were similar, although the value for the overburden was at the lower end of the bedrock range. The lower values in the overburden may be attributable to the presence of some fine-grained materials (i.e., silts and clays), whereas the secondary porosity of the shallow bedrock produces generally greater values.

Assuming porosity of 0.39 for the overburden and shallow bedrock (Batu, 1998), the groundwater seepage velocity in the overburden was calculated to be 0.25 foot per day (92 feet per year), and the groundwater seepage velocity in the shallow bedrock was calculated to be 0.30 foot per day (110 feet per year).

Nearby Public and Residential Wells

Prior to the subject groundwater investigation, there were no monitoring wells or private wells within the boundary of the site. Per recent aerial photography of the area, the closest house is located approximately 1,300 feet from the center of the Quarry site. Refer to Appendix A-9 for mapping of nearby public and residential wells.

GROUNDWATER ANALYTICAL RESULTS

Four groundwater samples were collected from wells (MW-QRY-01B, -02, -03, and -04 located at the Quarry Area on August 28 and August 29, 2012; dry well MW-QRY-01A could not be sampled. On December 2 through December 5, 2013, these wells were resampled, a sample was able to be collected from MW-QRY-01A, and newly installed wells MW-QRY-05 through -12 were sampled. Resulting groundwater quality data from laboratory analysis and reporting efforts were compared to Maximum Contaminant Levels (MCLs), EPA Regional Screening Levels (RSLs) for tap water (November 2013) and State of Maine Center for Disease Control (MECDC) Maximum Exposure Guidelines (MEGs) (2012). The complete validated analytical results are included in Appendix B-2.

A summary of the results and comparisons with criteria and facility background values (Tetra Tech, 2012e) is discussed below. No MCL exceedances were detected during the 2012 or 2013 event. Results for parameters detected at least once in groundwater samples collected during the comprehensive 2013 event of all 13 wells are shown in Table 6, and results for parameters detected at least once in groundwater samples collected during the 2012 event of only 4 wells in place are summarized in Table 7, which also includes comparisons to 2013 results. A tag map is presented as Figure 9.

VOCs

Chloroform, a common laboratory contaminant, was detected in groundwater from 2 of the 13 monitoring wells during the 2013 event, with a maximum concentration of 1.5 μ g/L, exceeding the RSL of 0.19 μ g/L but less than the MCL and MEG. Chloroform was previously detected in 3 of the 4 sampled wells in 2012, at a maximum concentration of 19 μ g/L, but chloroform was not detected in samples from these same 4 wells during the 2013 event.

Benzene was not detected in any of the monitoring wells during the 2013 event, but in 2012 benzene was detected in one sample, from MW-QRY-03, at 0.69 μ g/L, greater than the RSL of 0.39 μ g/L but less than the MCL and MEG. In addition to benzene, other fuel-related constituents such as xylenes and toluene were detected in 2013 but not at concentrations exceeding criteria.

Bromodichloromethane, a common field contaminant, was detected well MW-QRY-02 only during the 2012 event at a concentration of 1.9 μ g/L, which exceeds the RSL of 0.12 μ g/L but is less than the MCL and MEG. Bromodichloromethane was not detected at this well or any others during the 2013 event.

SVOCs, including Low-Level Polynuclear Aromatic Hydrocarbons (PAHs)

Benzo(a)anthracene was detected in groundwater from 4 of 13 monitoring wells during the 2013 event, with a maximum concentration of 0.23 μ g/L, exceeding the RSL of 0.029 μ g/L but less than the MCL and MEG. Benzo(a)anthracene was not detected in 2012 results. Other PAHs including chrysene, fluorene, and phenanthrene were sporadically detected during one or both events but not at concentrations

exceeding criteria.

3&4-Methylphenol was detected in groundwater from 1 of the 13 monitoring wells during the 2013 event at a concentration of 12 μ g/L, which exceeds the MEG 4 μ g/L for 4-methylphenol but not the 40 μ g/L MEG for 3-methylphenol (site speciation is unknown); other criteria were not exceeded. 3&4-Methylphenol was not detected during the 2012 event.

Explosives

RDX was detected in 2 of 13 wells sampled during the 2013 event, and the concentration at MW-QRY-12 (3.8 μ g/L) exceeded the RSL of 0.61 μ g/L and the MEG of 3 μ g/L. In addition to RDX, HMX was detected at the same well but at concentrations less than criteria. No other explosives were detected during either event.

Perchlorate

Perchlorate was detected in 3 of 13 wells during the 2013 event at a maximum concentration of 0.2 μ g/L, less than the RSL, MCL, and MEG. Perchlorate was detected in 2 of the 4 wells sampled during the 2012 event, again at concentrations less than criteria.

Metals

Several metals exceeded both facility background values and one or more criteria, including the following:

- Arsenic, which was detected in 2 of 13 wells during the 2013 event at concentrations exceeding the RSL of 0.045 μg/L (maximum concentration of 6.7 μg/L).
- Cobalt, which detected in all 13 wells during the 2013 event, with the maximum concentration, detected at MW-QRY-03, exceeding the MEG of 10 μg/L. However, the exceedance (12.2 μg/L) was only nominally greater than the facility background concentration (12.1 μg/L). The cobalt concentration at MW-QRY-03 in 2012 was 49.6 μg/L.
- Manganese, which detected in all 13 wells during the 2013 event, with concentrations exceeding the MEG (500 μg/L) and facility background value (547 μg/L bedrock, 173 μg/L upper sand) at three wells (maximum 3,070 μg/L at MW-QRY-05). At monitoring well MW-QRY-03 the 2013 manganese concentration was 1,300 μg/L, but the 2012 concentration was 4,830 μg/L.
- Nickel, which was detected in 3 of 13 wells during the 2013 event, with the concentration at one well (24 µg/L at MW-QRY-05) exceeding the MEG and facility background value (20 and 4.1 µg/L, respectively).

Pesticides

Pesticides were not detected during the 2013 event. During the 2012 event, alpha-chlordane, endosulfan

II, and gamma-chlordane were detected but at concentrations less than criteria.

PCBs

There were no detections of PCBs during either the 2013 or 2012 event.

EPH/VPH

There were no detections of EPH/VPH during either the 2013 or 2012 event.

CONCLUSIONS AND RECOMMENDATIONS

The installed monitoring wells appear to intercept flow paths for potential groundwater contamination. Groundwater contamination detected during the 2012/2013 groundwater investigation consisted mainly of low-level petroleum-related VOCs (benzene and xylenes), munitions-related explosives (HMX, RDX, and perchlorate), and metals (unknown origin). Perchlorate, which was detected in groundwater at concentrations less than criteria, is associated with munitions but also may be a residual component of the explosives used for historical rock quarrying operations. There were no exceedances of MCLs, however, MEG exceedances for the 2013 event included RDX (MW-QRY-12 only) and cobalt, manganese, and nickel (MW-QRY-05 for all three metals and manganese at three additional wells MW-QRY-03, -09, and 12)

Consideration of a geophysical assessment, using very low frequency (VLF) or ground penetrating radar (GPR) methods, considered in the Quarry Work Plan to identify deeper water-bearing fractures or to refine depth to groundwater, top of bedrock, or locations of sub-horizontal water-bearing fractures, does not appear to be warranted. However, these determinations will not be finalized until the soil, surface water, and sediment field investigation is planned and executed later in 2014 and evaluation conducted. The lack of significant soil contamination at the Quarry Area to date, as evidenced by visual observations and field screening of soil lithology samples and opportunity sampling and analysis of soils during the 2010 MEC exploratory trenching effort suggests that soil impacts, if any, are likely minimal, but the investigation was limited and further evaluation will be conducted during the pending soil investigation.

Risk assessment will be necessary pending the 2014 soil and sediment investigation completion. Groundwater should be included in the risk assessment to assess overall site risks. Groundwater monitoring should also be considered.

REFERENCES

Batu, Vedat, 1998. Aquifer Hydraulic: A Comprehensive Guide to Hydrogeologic Data Analysis. New York: John Wiley & Sons, Inc.

Bouwer and Rice method (Bouwer, 1989).

E.C. Jordan, 1991. Draft Final Supplemental RI Report. Chapter 9.

EPA (United States Environmental Protection Agency), 2013. Regional Screening Levels for Chemical Contaminants at Superfund Sites. RSL Table Update. http://epa-prgs.ornl.gov/chemicals/index.shtml. November.

Maine Geological Survey, 2013. Maine Geological Survey Water Well Shapefile, February. Downloaded September 4,. www.maine.gove/doc/nrimc/mgs/pubs/digital/well.htm

Malcolm Pirnie, 2007. Preliminary Assessment. Addendum, Naval Air Station Brunswick, Maine. July.

MECDC (Maine Center for Disease Control), 2012. Maximum Exposure Guidelines (MEGs) for drinking water. October 19.

Tetra Tech, 2009. Site Inspection Report for Munitions and Explosives of Concern Areas, Site 12 EOD Area, Munitions Bunker West Area, Quarry. Naval Air Station Brunswick, Maine. June.

Tetra Tech, 2011. Exploratory Munitions and Explosives of Concern Investigation Report for Quarry Area. Naval Air Station Brunswick, Maine. March (draft).

Tetra Tech, 2012a. Work Plan, Groundwater Investigation, Quarry Area. Former Naval Air Station Brunswick, Maine. August.

Tetra Tech, 2012b. Sampling and Analysis Plan, Munitions Constituents Remedial Investigation of Site 12 EOD Area. Former Naval Air Station Brunswick, Maine. May 5.

Tetra Tech, 2012c. Technical Memorandum Groundwater Report Quarry Area. Former Naval Air Station Brunswick, Maine. November.

Tetra Tech, 2012d. Bedrock Fracture Trace Analysis Report, Quarry Area and Site 12 EOD. Former Naval Air Station Brunswick, Maine. August.

Tetra Tech, 2012e. Background Study Report for Naval Air Station Brunswick, Brunswick, Maine. March

Tetra Tech, 2013. Work Plan Addendum, Groundwater Investigation, Quarry Area. Former Naval Air Station Brunswick, Maine. October.

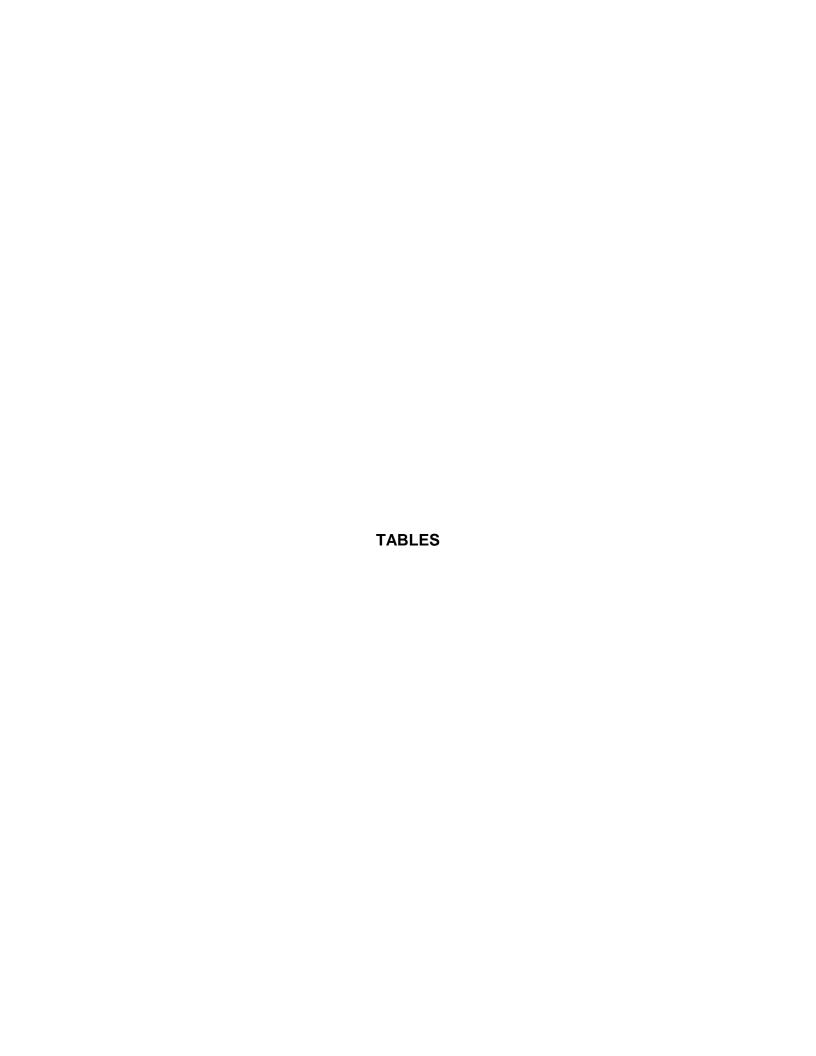


TABLE 1 MONITORING WELL CONSTRUCTION/WATER LEVEL SUMMARY **QUARRY AREA** FORMER NAVAL AIR STATION BRUNSWICK, MAINE

										Augus	t 28, 2012	October	12, 2012	October	28, 2013	Decemb	er 2, 2013
Well Identification	Year Installed	Geologic Unit Screened	Well Inside Diameter (inches)	Ground Elevation (ft NAVD88)	Reference Point ⁽¹⁾ (ft NAVD88)	Depth to Top of Well Screen (ft bgs)	Depth to Bottom of Well Screen (ft bgs)	Depth to Top of Bedrock (ft bgs)	Depth to Top of Bedrock (ft NAVD88)	Depth to Water ^(2,3) (ft from Reference Point)	Water Elevation ⁽¹⁾ (ft NAVD88)	Depth to Water ^(2,3) (ft from Reference Point)	Water Elevation ⁽¹⁾ (ft NAVD88)	Depth to Water ^(2,3) (ft from Reference Point)	Water Elevation ⁽¹⁾ (ft NAVD88)	Depth to Water ^(2,3) (ft from Reference Point)	Water Elevation ⁽¹⁾ (ft NAVD88)
Monitoring Wells																	
MW-QRY-01A	2012	Bedrock	2	110.50	113.07	13.0	18.0	11.90	98.60	No Water	Dry	No Water	Dry	No Water	Dry	18.18	94.89
MW-QRY-01B	2012	Bedrock	2	110.37	113.03	18.0	28.0	8.50	101.87	25.23	87.80	25.22	87.81	22.95	90.08	18.13	94.90
MW-QRY-02	2012	Bedrock	2	102.82	105.68	12.0	22.0	7.50	95.32	18.13	87.55	17.25	88.43	16.87	88.81	15.62	90.06
MW-QRY-03	2012	Upper Sand	2	92.81	95.31	5.5	10.5	31.00	61.81	9.25	86.06	9.22	86.09	8.72	86.59	8.07	87.24
MW-QRY-04	2012	Bedrock	2	94.40	97.25	8.0	16.0	6.25	88.15	9.28	87.97	8.48	88.77	7.67	89.58	6.11	91.14
MW-QRY-05	2013	Bedrock	2	94.65	97.24	9.0	19.0	6.00	88.65	NI		NI		NI		6.43	90.81
MW-QRY-06	2013	Bedrock	2	106.61	109.29	16.0	26.0	4.50	102.11	NI		NI		NI		17.58	91.71
MW-QRY-07	2013	Bedrock	2	90.91	93.44	17.0	27.0	13.25	77.66	NI		NI		NI		3.52	89.92
MW-QRY-08	2013	Bedrock	2	99.71	102.43	6.5	16.5	4.25	95.46	NI		NI		NI		4.96	97.47
MW-QRY-09	2013	Upper Sand	2	94.15	96.34	6.0	13.0	33.50	60.65	NI		NI		NI		9.33	87.01
MW-QRY-10	2013	Upper Sand	2	89.33	91.60	9.0	14.0	13.30	76.03	NI		NI		NI		12.53	79.07
MW-QRY-11	2013	Upper Sand	2	91.55	93.97	5.5	10.5	NE	<81.05	NI		NI		NI		9.88	84.09
MW-QRY-12	2013	Bedrock	2	90.28	92.77	7.3	17.3	4.25	86.03	NI		NI		NI		2.81	89.96
Staff Gauge																	
SG-QRY-01	2012	NA	NA	NA	90.96	NA	NA	NA	NA	2.44	88.52	2.65	88.31	1.25	89.71	0.11	90.85
SG-QRY-02	2012	NA	NA	NA	88.29	NA	NA	NA	NA	No Water	Dry	2.80	85.49	Below bottom of gauge	Dry	2.91	85.38
SG-QRY-03	2013	NA	NA	86.72	89.43	NA	NA	NA	NA	NA	NA	2.3	87.13	1.40	88.03	2.09	87.34

¹ Elevations are feet relative to the National Geodetic Vertical Datum of 1988 (NAVD1988). Monitoring well reference points are the tops of the PVC casing, and staff gauge reference point is the 3-foot mark.

bgs - Below ground surface.

ft - Feet.

NA - Not applicable. NE - Not encountered.

NI - Not installed.

PVC - Polyvinyl chloride.

² Observed water level on staff gauge.

³ Depths to water at staff gauge locations were calculated by the subtracting the observed water level on the staff gauge from the reference point of 3 feet.

TABLE 2 GROUNDWATER FIELD PARAMETER SUMMARY QUARRY AREA FORMER NAVAL AIR STATION BRUNSWICK, MAINE

Well Identification	Sample Date	Purge Rate (ml/ min)	Total Volume Purged (gallons)	Temperature (°C)	Specific Conductivity (uS/cm)	рН	ORP (mV)	DO (mg/L)	Turbidity (NTU)	PID Reading (ppm)
MW-QRY-01A	12/5/2013	270	3.5	9.86	170	6.63	186.9	8.72	3.18	0
MW-QRY-01B	8/29/2012	250	3.3	9.50	207	7.38	-28.3	7.47	2.30	0
WW-QKT-UTB	12/2/2013	400	3	9.19	156	6.60	224.9	6.90	1.01	0
MW-QRY-02	8/28/2012	45	1.6	15.78	170	6.23	156.0	5.61	0.00	0
INIVV-QR 1-02	12/3/2013	405	6	9.86	114	5.35	208.8	6.91	0.26	0
MW-QRY-03	8/28/2012	250	2	14.88	206	6.09	78.4	0.31	4.27	0.2
INIVI-QR 1-03	12/2/2013	150	3	8.57	201	6.21	68.5	1.09	27.5	0.1
MW-QRY-04	8/29/2012	300	3	13.53	257	6.29	67.4	0.17	2.89	0
MW-QK1-04	12/4/2013	455	2	8.92	136	6.08	66.5	0.64	7.48	0
MW-QRY-05	12/4/2013	300	4	9.91	494	6.82	2.1	0.51	7.95	0
MW-QRY-06	12/3/2013	420	5	9.59	80	5.61	230.4	6.87	1.34	0
MW-QRY-07	12/4/2013	220	3.5	8.66	201	7.77	-122.7	0.47	9.6	0
MW-QRY-08	12/4/2013	355	4.5	8.89	72	4.15	290.1	8.30	0.80	0
MW-QRY-09	12/5/2013	270	3	9.93	57	5.41	253.3	4.47	4.70	0
MW-QRY-10	12/3/2013	90	2	8.10	96	6.42	160.8	1.27	9.7	0
MW-QRY-11	12/3/2013	150	1.7	8.88	65	5.90	224.0	3.14	0.19	0
MW-QRY-12	12/5/2013	485	5	9.89	415	6.60	127.6	0.25	6.40	0

°C - Degrees Celsius. NTUs - Nephelometric turbidity units.
DO - Dissolved oxygen. ORP - Oxidation-reduction potential.
ft bgs - Feet below ground surface. mg/ PID - Photoionization detector.

mg/L - Milligrams per liter. ppm - Parts per million

mL/min - Milliliters per minute. uS/cm - MicroSiemens per centimeter.

mV- Millivolts.

TABLE 3 **GROUNDWATER 2012 AND 2013 SAMPLE SUMMARY QUARRY AREA** FORMER NAVAL AIR STATION BRUNSWICK, MAINE

Sample Identification	Well	Geologic	Analyses
• • • • • • • • • • • • • • • • • • • •	Identification	Unit	

August 2012 Sampling Event

QRYD9GW001B-0812	MW-QRY-01B	Bedrock	
QRYD9GW002-0812	MW-QRY-02	Bedrock	VOCs, EDB, VPH, EPH, SVOCs, Explosives plus
QRYD9GW003-0812 QRYD9GW003-0812-D	MW-QRY-03	Upper Sand	Nitroglycerine, Perchlorate, PCBs/Pesticides, Metals
QRYD9GW004-0812	MW-QRY-04	Bedrock	

December 2013 Sampling Event

QRYD9GW01A-1213	MW-QRY-01A	Bedrock	
QRYD9GW01B-1213	MW-QRY-01B	Bedrock	
QRYD9GW02-1213	MW-QRY-02	Bedrock	
QRYD9GW03-1213	MW-QRY-03	Upper Sand	
QRYD9GW04-1213	MW-QRY-04	Bedrock	
QRYD9GW05-1213	MW-QRY-05	Bedrock	
QRYD9GW06-1213	MW-QRY-06	Bedrock	VOCs, EDB, VPH, EPH, SVOCs, Explosives plus Nitroglycerine, Perchlorate, PCBs/Pesticides, Metals
QRYD9GW07-1213	MW-QRY-07	Bedrock	Nittogrycenne, retailorate, robs/resticides, inetais
QRYD9GW08-1213	MW-QRY-08	Bedrock	
QRYD9GW09-1213 QRYD9GW09-1213-D	MW-QRY-09	Upper Sand	
QRYD9GW10-1213	MW-QRY-10	Upper Sand	
QRYD9GW11-1213	MW-QRY-11	Upper Sand	
QRYD9GW12-1213	MW-QRY-12	Bedrock	

D - Duplicate

EDB - Ethylene dibromide.

EPH - Extractable petroleum hydrocarbons.

PCBs - Polychlorinated biphenyls. SVOCs - Semivolatile organic compounds.

VOCs - Volatile organic compounds.

VPH - Volatile petroleum hydrocarbons.

TABLE 4

GROUNDWATER QUALITY CONTROL 2012 AND 2013 SAMPLE SUMMARY QUARRY AREA FORMER NAVAL AIR STATION BRUNSWICK, MAINE

Sample Identification	QC Sample Type	Analysis
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August 2012 Sampling Event

QRY/12GWFB01-082712	Field Blank	VOCs, EDB, VPH, EPH, SVOCs, Explosives
QRYD9GWRB01-082812	Rinsate Blank	plus Nitroglycerine, Perchlorate, PCBs/Pesticides, Metals
QRY/12GWTB01-082712	Trip Blank	VOCs, EDB, VPH
QRY/12GWTB01-082812	Trip Blank	

December 2013 Sampling Event

QRYD9GWRB01-120513	Rinsate Blank	VOCs, EDB, VPH, EPH, SVOCs, Explosives plus Nitroglycerine, Perchlorate, PCBs/Pesticides, Metals				
QRYD9-TB120213	Trip Blank	VOO. EDD VDU				
QRYD9-TB120413	Trip Blank	VOCs, EDB, VPH				

EDB - Ethylene dibromide.

EPH - Extractable petroleum hydrocarbons. PCBs - Polychlorinated biphenyls.

QC - Quality Control

SVOCs - Semivolatile organic compounds. VOCs - Volatile organic compounds. VPH - Volatile petroleum hydrocarbons.

TABLE 5

BULK HYDRAULIC CONDUCTIVITY ESTIMATES QUARRY AREA NAVAL AIR STATION BRUNSWICK, BRUNSWICK, MAINE

Well	Screened	Toot Time	Hydraulic Cor	nductivity (K)	Arithmetic Mean K			
weii	Interval	Test Type	(feet per day)	(cm/sec)	(feet per day)	(cm/sec)		
MW-QRY-03	Upper	Falling	1.10E+01	3.89E-03	1.25E+01	4.42E-03		
	Sand	Rising	1.41E+01	4.96E-03	1.256+01	4.426-03		
MW-QRY-09	Upper Sand	Rising	6.34E+00	2.24E-03	6.34E+00	2.24E-03		
MW-QRY-10	Upper Sand	Rising	6.14E-01	2.17E-04	6.14E-01	2.17E-04		
		Ge	ometric Mean K	Upper Sand	3.65E+00	1.29E-03		
MW-QRY-01B	Bedrock	Falling	3.82E+01	1.35E-02	4.76E+01	1.68E-02		
		Rising	5.70E+01	2.01E-02	4.70L+01	1.00L-02		
MW-QRY-02	Bedrock	Rising	3.65E+01	1.29E-02	3.65E+01	1.29E-02		
MW-QRY-07	Bedrock	Falling	6.77E-01	2.39E-04	6.84E-01	2.41E-04		
		Rising	6.90E-01	2.44E-04	0.046-01	2.416-04		
MW-QRY-12	Bedrock	Falling	1.46E+01	5.15E-03	1.66E+01	5.85E-03		
		Rising	1.86E+01	6.55E-03	1.002701	J.65E-03		
		Ge	ometric Mean K	Bedrock	1.18E+01	4.18E-03		

TABLE 6 GROUNDWATER SAMPLING EVENT POSITIVE RESULTS, DECEMBER 2013 QUARRY AREA

FORMER NAS BRUNSWICK MAINE

SAMPLE LOCATION						QRY-MW01A	/01A QRY-MW01B	QRY-MW02	QRY-MW03	QRY-MW04	QRY-MW05	QRY-MW06	QRY-MW07	QRY-MW08	QRY-	MW09	QRY-MW10	QRY-MW11	QRY-MW12
SAMPLE DATE	MEG	MCL	RSL	BACKGI	ROUND	12/05/2013	12/02/2013	12/03/2013	12/02/2013	12/04/2013	12/04/2013	12/03/2013	12/04/2013	12/04/2013	12/05/2013	12/05/2013	12/03/2013	12/03/2013	12/05/2013
QC TYPE	20			BR	US	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal	Normal	Normal
WELL TYPE						BR	BR	BR	US	BR	BR	BR	BR	BR	US	US	US	US	BR
EXPLOSIVES (ug/L)						=													
HMX	400	NA	7800	NA	NA	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.61
RDX	3	NA	0.61	NA	NA	0.2 J	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	3.8
METALS (ug/L)						_													
ALUMINUM	7000	NA	160000	1930	1930	99.6 J	40 U	44.3 U	53.3 U	82.2 J	41.3 U	40 U	739	1740	266 J	324	73.2 J	40 U	70.2 J
ARSENIC	10	10	0.045	NA	13.8	4 U	4 U	4 U	4 U	4 U	4 U	4 U	6.7	2.3 J	4 U	4 U	4 U	4 U	4 U
BARIUM	1000	2000	29000	43.3	43.3	19.9	48	53.8	23.8	80.4	189	57.2	29.6	82.4	37.8	39.5	19	27.9	89.4
BERYLLIUM	10	4	160	NA	0.27	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.36 J	0.24 J	0.23 J	0.2 U	0.2 U	0.2 U
CALCIUM	NA	NA	NA	21800	9640	26900	26200	14200	23000	19600	81400	9730	31200	3310	2010	2110	12000	8080	78800
COBALT	10	NA	47	12.1	12.1	0.1 J	0.1 J	0.66 J	12	0.88 J	12.2	0.11 J	0.17 J	10.7	2.6	2.8	0.94 J	0.12 J	0.27 J
COPPER	500	1300	6200	13.9	1.5	2 U	2 U	6.4 U	3 U	11.1	3.8 U	3.5 U	5.9 U	15.6	2.5 U	2 U	2 U	2.4 U	18.5
IRON	5000	NA	110000	5090	2100	131	53.4 J	28.4 J	1940	376	738	43.2 J	461	54.2 J	58.2 J	43.6 J	77.8 J	17.7 J	249
LEAD	10	15	NA	2.2	0.66	0.5 U	0.5 U	0.5 U	0.5 U	8.9	0.5 U	0.5 U	0.91 U	0.66 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MAGNESIUM	NA	NA	NA	13600	2270	2420	1740	1200	5700	2240	8280	1820	5820	1330	830	841	2600	1390	6460
MANGANESE	500	NA	3200	547	173	5.4	2.4	8.3	1300	333	3070	11.9	164	270	637	638	216	10.9	1670
NICKEL	20	NA	3000	4.1	4.1	1.2 U	1.2 U	1.2 U	5.6	2.4 U	24	1.2 U	1.2 U	19.1	1.8 U	2.1 U	2.5 U	1.2 U	1.8 U
POTASSIUM	NA	NA	NA	3340	1790	3390	3250	3260	3180	4610	16400	3230	3900	1580	1120	1130	2100	1570	9160
SILVER	40	NA	710	ND	ND	0.08 J	0.09 J	0.4 U	0.4 U	0.1 J	0.4 U	0.4 U	0.1 J	0.4 U					
SODIUM	20000	NA	NA	31600	67800	4570	3430	7040	4360	3320	7790	4080	5360	3120	6600	6730	4980	3400	5760
ZINC	2000	NA	47000	18.5	6.1	8 U	8 U	8 U	8 U	19.1	8 U	8 U	8 U	31.6	11.6	8.3 J	8 U	8 U	8 U
MISC (ug/L)					1	•	L						l	l			l .		<u> </u>
PERCHLORATE	0.8	15	110	NA	NA	0.133 J	0.1 U	0.2 J	0.1 U	0.1 U	0.1 U	0.2 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
SEMIVOLATILES (ug/L)		1						<u> </u>					<u> </u>		<u>I</u>	<u>I</u>			
3&4-METHYLPHENOL	40, 4	NA	140	NA	NA	7.1 U	7.5 U	7.7 U	7.1 U	12	7.1 UJ	7.6 U	7.2 U	7.3 U	7.1 U	7.2 U	7.6 U	7.2 U	7.2 U
VOLATILES (ug/L)							I.	<u> </u>				1	. J		<u>I</u>	<u>I</u>			
CHLOROFORM	70	80	0.19	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.3 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	1.5	0.5 U
TOLUENE	600	1000	860	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	33	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
PAHS (ug/L)		1			1									1	ı	1			
BENZO(A)ANTHRACENE	0.5	NA	0.029	NA	NA	0.095 UJ	0.23 J	0.1 U	0.22 J	0.097 UJ	0.23 J	0.1 UJ	0.096 UJ	0.097 UJ	0.094 UJ	0.096 UJ	0.1 U	0.22 J	0.096 UJ
CHRYSENE	50	NA	2.9	NA	NA	0.095 UJ	0.1 U	0.061 J	0.094 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ	0.094 UJ	0.096 UJ	0.061 J	0.096 U	0.096 UJ
FLUORENE	300	NA	2200	NA	NA	0.095 UJ	0.1 U	0.1 U	0.094 U	0.097 UJ	0.062 J	0.1 U	0.096 UJ	0.097 UJ	0.094 UJ	0.096 UJ	0.1 U	0.096 U	0.096 UJ
PHENANTHRENE	NA	NA	NA	NA	NA	0.095 UJ	0.1 U	0.1 U	0.094 U	0.097 UJ	0.19 J	0.1 U	0.096 UJ	0.097 UJ	0.094 UJ	0.096 UJ	0.1 U	0.096 U	0.096 UJ
Highlighted cell indicates an exce	edance of facility ba	ackground (BKG) AND criteria	(less stringent	of MEG, MC	L or RSL). Backg	round data set as a	ppropriate for Bed	drock Well (BR) or U	Jpper Sand (US)	Well. Bolded va	lues indicate exce	eedance of applica	ble BKG.					

Samples were also analyzed for Pesticides, Polychlorinated Biphenyls (PCBs), and Extractable/Volatile petroleum hydrocarbons (EPH/VPH), but all results were non-detect.

BKG = Background

BR = Bedrock

J = Estimated

MCL = Maximum Contaminant Level (USEPA, November 2013)

MEG = Maine Exposure Guideline (MEDEP, October 19, 2012)

NA = Not enough detected samples to calculate a meaningful UPL RSL = Regional Screening Level (USEPA, November 2013) U = nondetect, detection limit shown

US = Upper Sand

TABLE 7 GROUNDWATER SAMPLING EVENT RESULTS, COMPARISON OF 2012 AND 2013 DATA QUARRY AREA

FORMER NAS BRUNSWICK, MAINE

								SVVICK, IVIAII	1 —						
SAMPLE LOCATION				BACKGROUND		QRY-MW01B	QRY-MW01B	QRY-MW02	QRY-MW02	QRY-MW03	QRY-MW03	QRY-MW03	QRY-MW04	QRY-MW04	
SAMPLE DATE	MEG	MCL	RSL	BACKG	BACKGROUND		12/02/2013	8/28/2012	12/03/2013	8/28/2012	8/28/2012	12/02/2013	8/29/2012	12/04/2013	
QC TYPE	WILG	WIOL	I NOL	BR	US	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal	Normal	Normal	
WELL TYPE						Е	3R	BR			US		BR		
METALS (ug/L)															
ALUMINUM	7000	NA	160000	1930	1930	40 U	40 U	40 U	44.3 U	60.4 J	58.4 J	53.3 U	98.9 J	82.2 J	
BARIUM	1000	2000	29000	43.3	43.3	32.1	48	48.7	53.8	59.8	58.5	23.8	225	80.4	
CADMIUM	1	5	69	NA	ND	0.2 U	0.2 U	0.04 J	0.2 U	0.13 J	0.12 J	0.2 U	0.09 J	0.2 U	
CALCIUM	NA	NA	NA	21800	9640	31700	26200	21500	14200	28600	28100	23000	47200	19600	
COBALT	10	NA	47	12.1	12.1	0.3 UJ	0.1 J	0.1 J	0.66 J	49.6	48.9	12	1	0.88 J	
COPPER	500	1300	6200	13.9	1.5	0.94 J	2 U	2.1 J	6.4 U	5	3.2	3 U	5.9	11.1	
IRON	5000	NA	110000	5090	2100	90.4 J	53.4 J	40.3 J	28.4 J	2540	2640	1940	194	376	
LEAD	10	15	NA	2.2	0.66	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	8.9	
MAGNESIUM	NA	NA	NA	13600	2270	1740	1740	2110	1200	6400	6310	5700	6040	2240	
MANGANESE	500	NA	3200	547	173	36.8	2.4	54.8	8.3	4830	4740	1300	454	333	
NICKEL	20	NA	3000	4.1	4.1	1.2 U	1.2 U	1.2 U	1.2 U	11.5	11.1	5.6	4.4	2.4 U	
POTASSIUM	NA	NA	NA	3340	1790	5660	3250	2050	3260	3120	3140	3180	10600	4610	
SILVER	40	NA	710	ND	ND	0.4 U	0.09 J	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.1 J	
SODIUM	20000	NA	NA	31600	67800	3950	3430	5270	7040	6380	6250	4360	11200	3320	
VANADIUM	200	NA	630	ND	4.6	1.2 J	4 U	0.93 J	4 U	4 U	0.98 J	4 U	0.94 J	4 U	
ZINC	2000	NA	47000	18.5	6.1	8 U	8 U	8 U	8 U	4.9 J	8 U	8 U	7.5 J	19.1	
MISC (ug/L)										•	•		•		
PERCHLORATE	0.8	15	110	NA	NA	0.055 J	0.1 U	0.12 J	0.2 J	0.12 UJ	0.12 UJ	0.1 U	0.04 U	0.1 U	
SEMIVOLATILES (ug/L)	•	•	•	•	•	•			•	•	•	•	•		
3&4-METHYLPHENOL	40, 4	NA	140	NA	NA	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 UR	7.1 U	7.1 U	12	
VOLATILES (ug/L)			_ _	Į.							•		•		
BENZENE	4	5	0.39	NA	NA	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.68 J	0.69 J	0.5 UJ	0.5 U	0.5 U	
CHLOROFORM	70	80	0.19	NA	NA	3.6	0.5 U	19	0.5 U	0.5 U	0.5 U	0.5 U	5.2	0.5 U	
M+P-XYLENES	NA	NA	19	NA	NA	1 U	1 U	1 U	1 U	1.3 J	1.4 J	1 U	1 U	1 U	
TOLUENE	600	1000	860	NA	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	33	
TOTAL XYLENES	1000	10000	19	NA	NA	1.5 U	1.5 U	1.5 U	1.5 U	1.3 J	1.4 J	1.5 U	1.5 U	1.5 U	
PAHS (ug/L)		•	•												
BENZO(A)ANTHRACENE	0.5	NA	0.029	NA	NA	0.094 UJ	0.23 J	0.095 UJ	0.1 U	0.094 UJ	0.095 UJ	0.22 J	0.095 UJ	0.097 UJ	
CHRYSENE	50	NA	2.9	NA	NA	0.094 UJ	0.1 U	0.095 U	0.061 J	0.094 U	0.095 U	0.094 U	0.095 U	0.097 UJ	
FLUORENE	300	NA	2200	NA	NA	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.073 J	0.094 U	0.095 U	0.097 UJ	
PESTICIDES (ug/L)	•	•	•					_			•		. <u> </u>		
ALPHA-CHLORDANE	NA	2	0.19	NA	NA	0.0061 J	0.0047 U	0.0047 U	0.0048 U	0.0047 U	0.0047 U	0.0048 U	0.0047 U	0.0048 UJ	
ENDOSULFAN II	40	NA	7.8	NA	NA	0.01 UJ	0.0094 U	0.002 J	0.0097 U	0.0094 UJ	0.0094 UJ	0.0096 U	0.0094 UJ	0.0096 U	
GAMMA-CHLORDANE	NA	2	0.19	NA	NA	0.0073 J	0.0047 U	0.0047 UJ	0.0048 U	0.0047 UJ	0.0047 UJ	0.0048 U	0.0047 UJ	0.0048 UJ	

Samples were analyzed for explosives, Polychlorinated Biphenyls (PCBs), and Extractable/Volatile petroleum hydrocarbons (EPH/VPH), but all results were non-detect.

BKG = Background

BR = Bedrock

J = Estimated

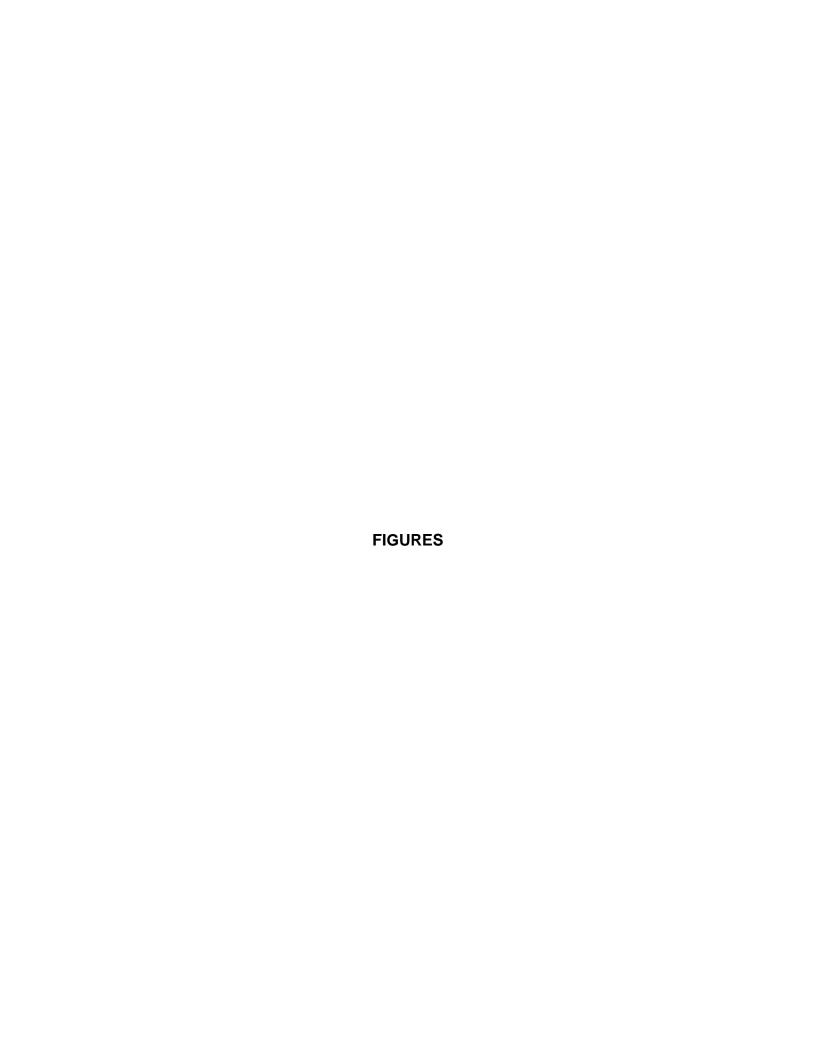
MCL = Maximum Contaminant Level (USEPA, November 2013)

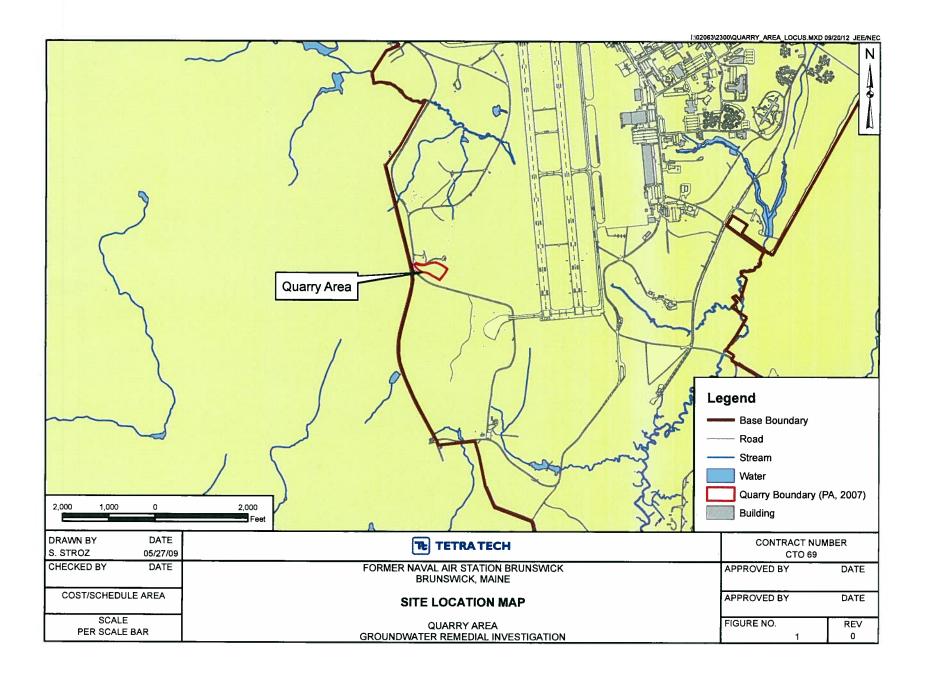
MEG = Maine Exposure Guideline (MEDEP, October 19, 2012)

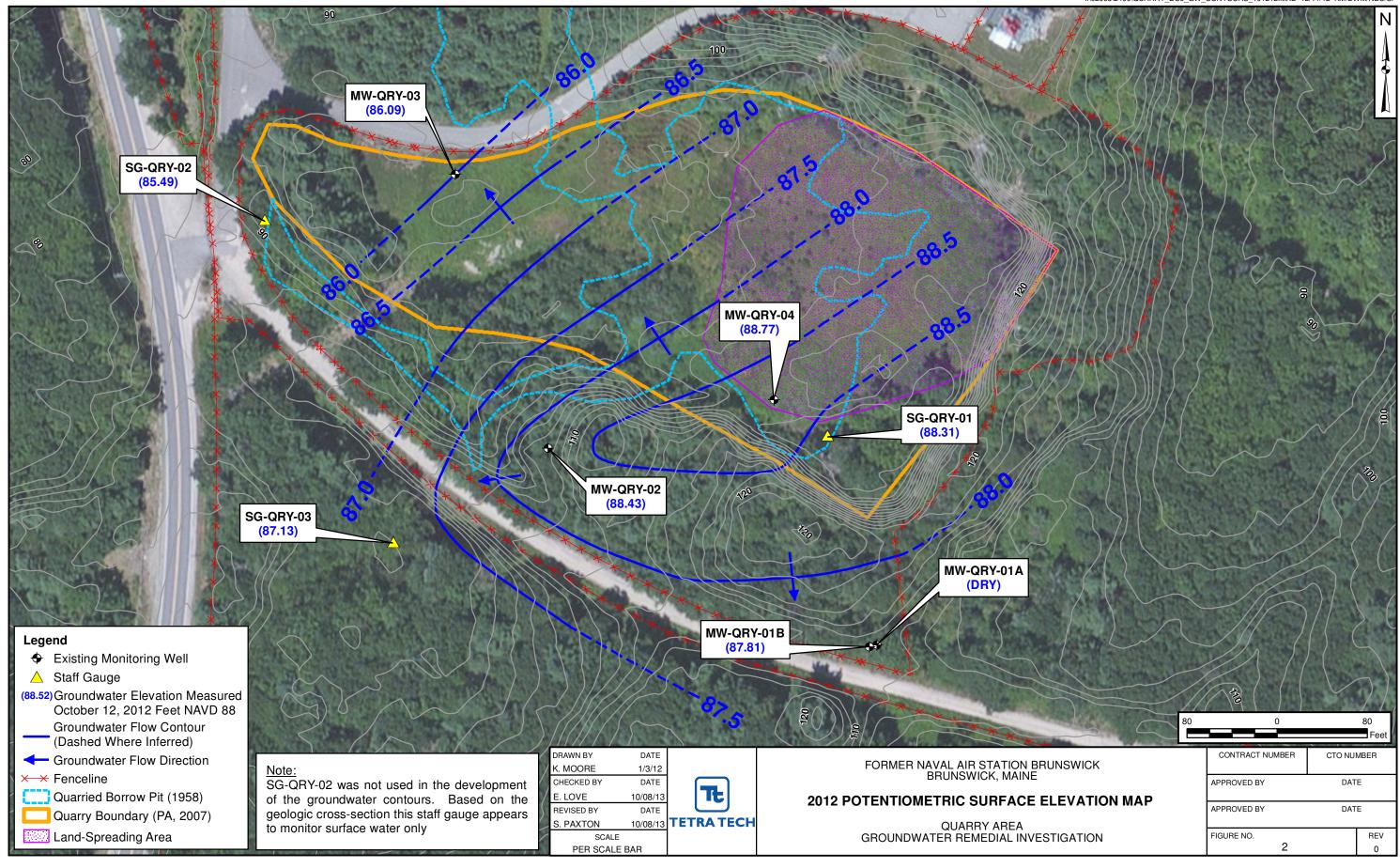
NA = Not enough detected samples to calculate a meaningful UPL RSL = Regional Screening Level (USEPA, November 2013)

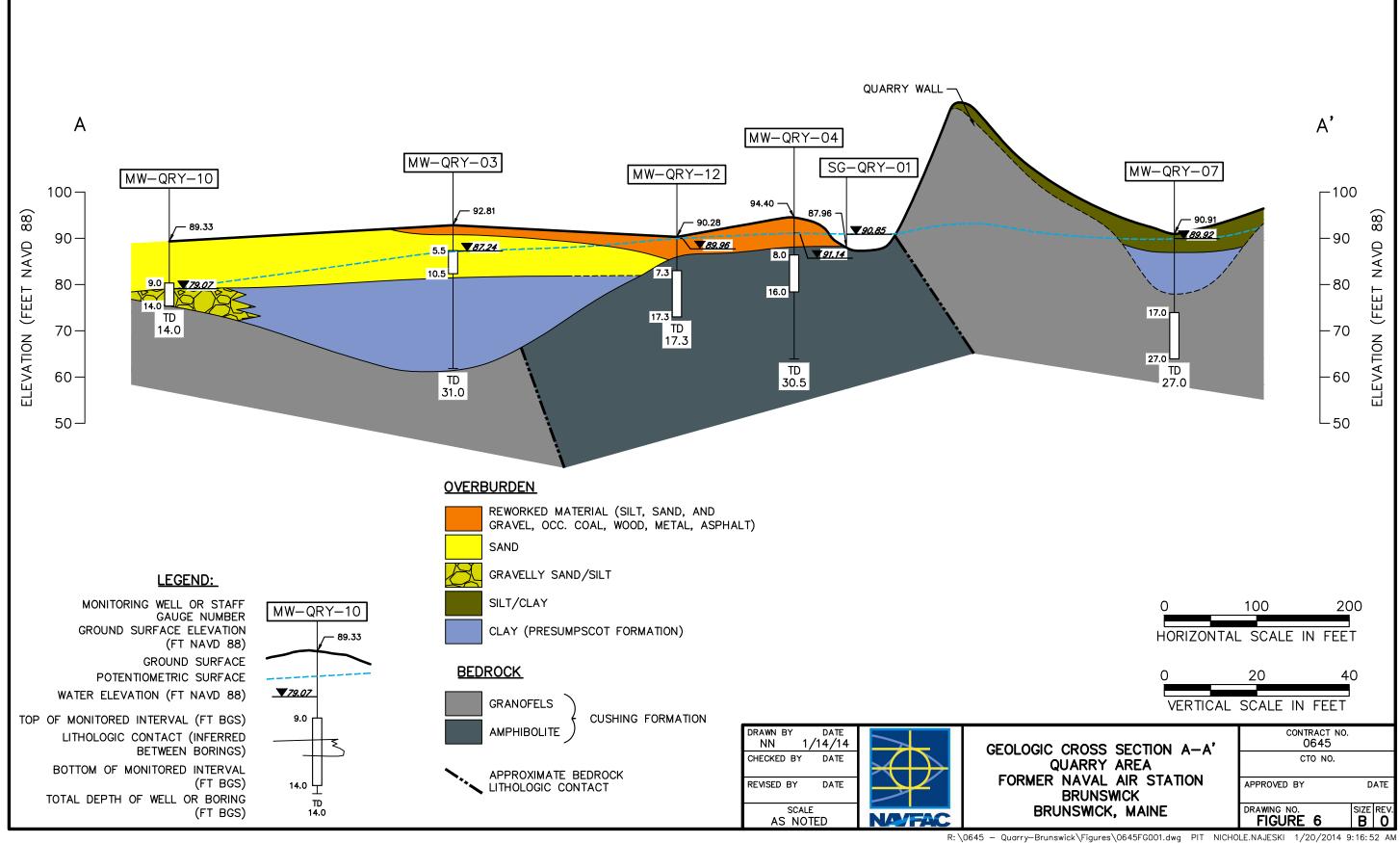
U = nondetect, detection limit shown

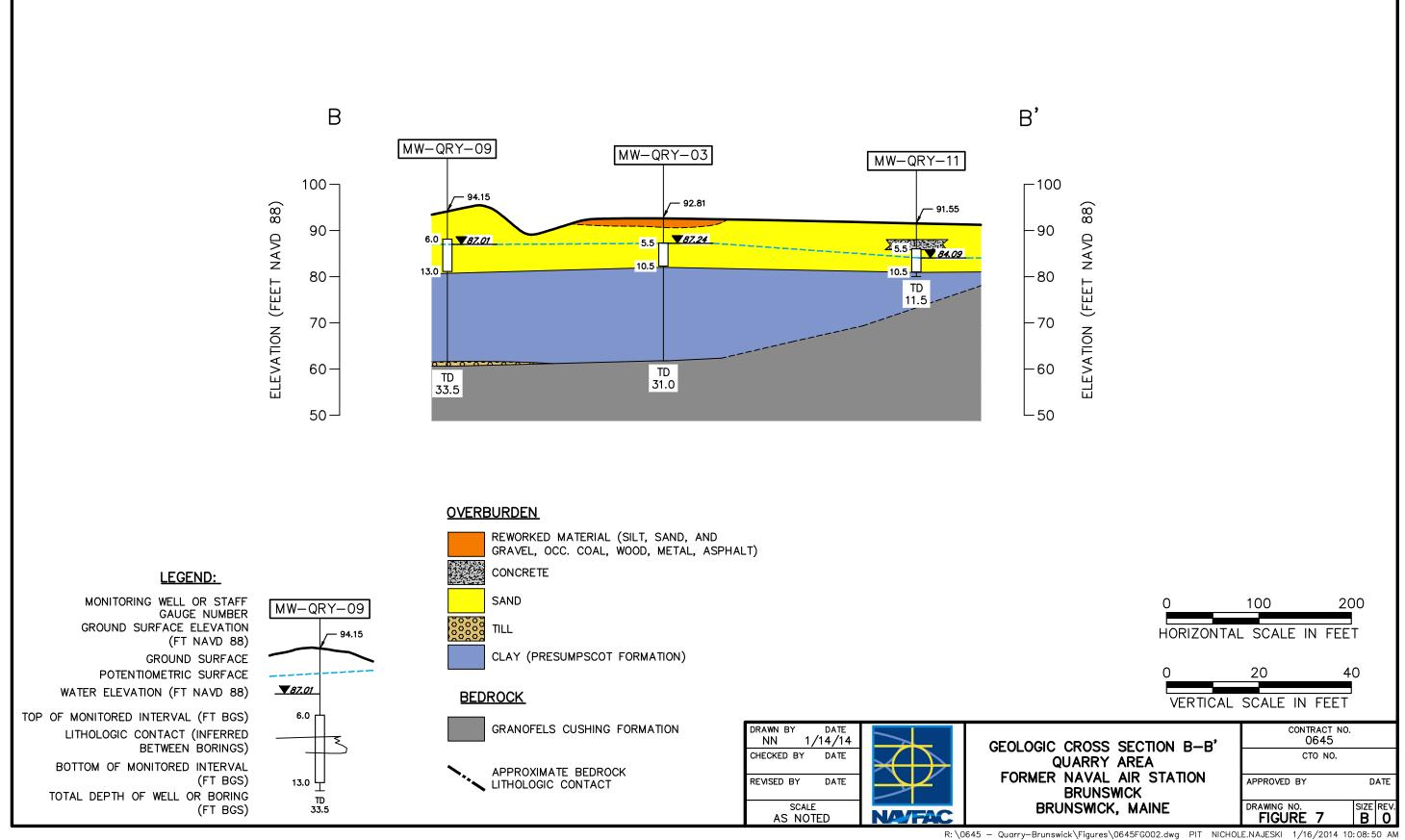
US = Upper Sand

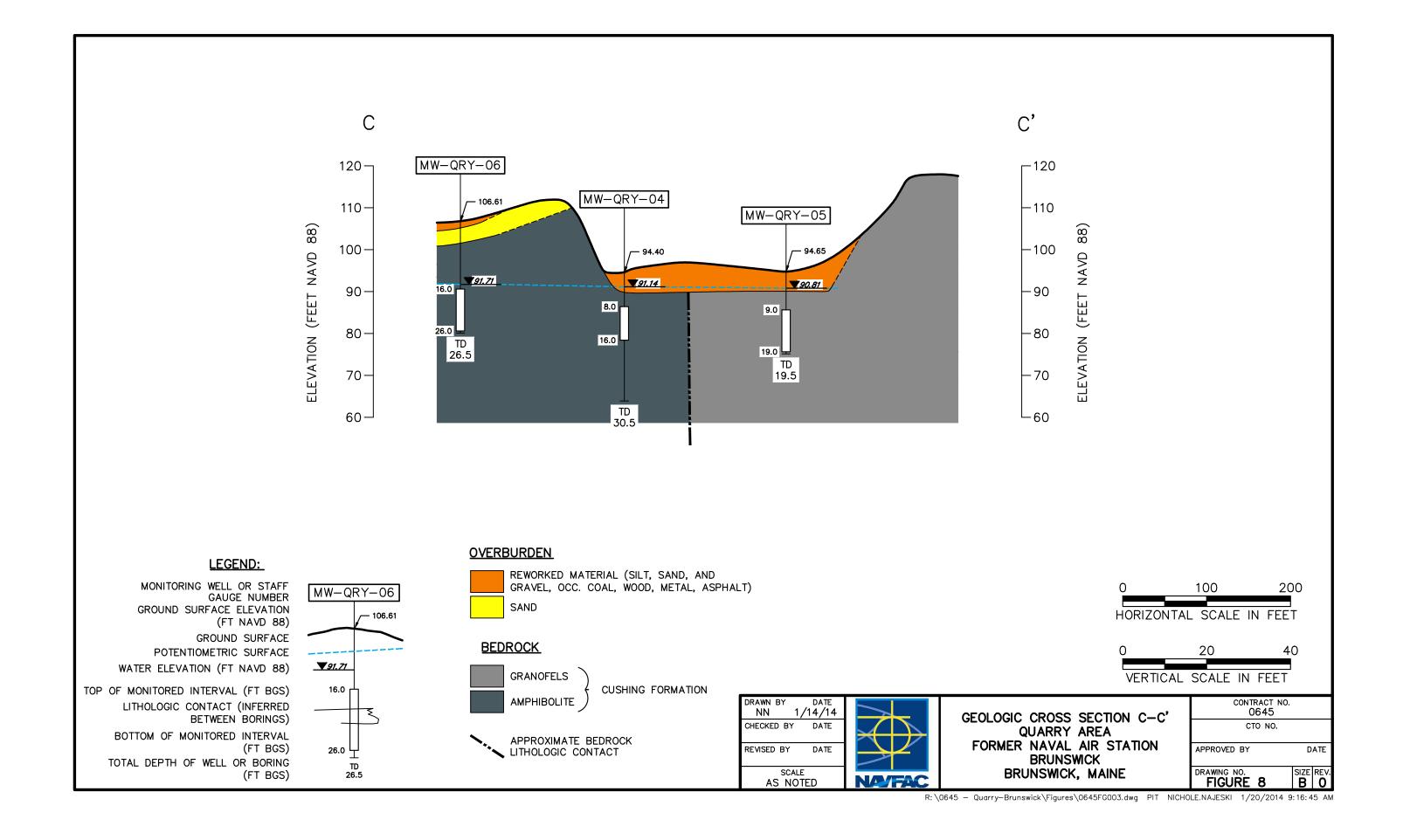




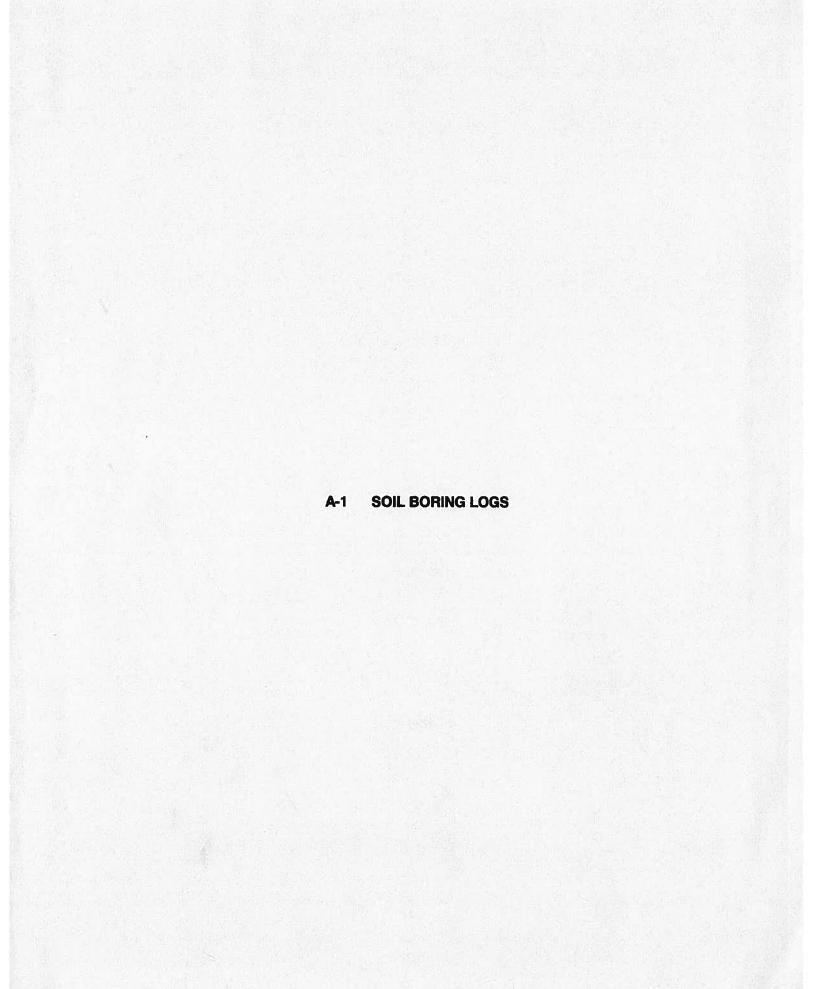








APPENDIX A
FIELD FORMS



|--|

PROJECT NO .:

112G00645/112G02063

LOGGED BY:

B.Geringer

GRD. SURFACE ELEVATION:

DRILLED BY (Company/Driller): East Coast Explorations / C. Palmer

110,50 MSL

TRANSCRIBED BY:

ELEVATION FROM: NAVD 88

BORING NO.: START DATE:

COMPLETION: DATE:

08/15/12 08/16/12

MON. WELL NO.: CHECKED BY:

MW-QRY-OIA

NASB-SB-GRY-OIA

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
	32	1.0	1310 -	Moved Boselsole	MED, DENSE	Brown	Sand(F), Some Sit (0.0-0.5) Rodo(0.5-0.7)	SM	Moist roots Pieces of Plastic	S=0.0 H=0.0 S=0.0 H=0.0
a		2.0		2'	V	Brown	Sand(F) : Silt, T-Gravel(0,7-1.0)	V	Dry - Hit Rack	5=00H=09 5=00H=00
. —	20	1.4	1325	TOPSOIL	MED. Dense	Brown	Sand(F) Some Silt (0.0-0.6)	SM	Moist, rocks, Plastic	5=0,0 H=0.0 S=0.0 H=0.0
ત	30 38	2.0	CNC		DENSE	Brown		GP	Dry	200H200
	20 34	1.9/	1337	FILL	med. Dense		Sand(F-c) + Gravel, T-Silt (0.0-1.9)	İ	Few	5=0.0 H=0.0 S=0.0 H=0.0
4	31 35	20	130 (DENSE	1	V	1	- Cosuco	5=0.0 H=0.0 S=0.0 H=0.0
	00/5	4	1410		med, Dense	Brown	SAA(0.0-0.5), Some moteling	GP	moist	\$20,0 H20,0
Ġ	- 0	2.0	1410	w a	Stiff	Brown	clay, T-silt (0.5-1.1)	CL	1	250'0 H20'0
	13	12/	1421	CLAY			SAA(0.0-1.2)	-	moist	2=0.0 H=0.0 2=0.0 H=0.0
8	12	2.0					j			5=0.0 H=0.0 \$=0.0 H=0.0
	16	20/	14147		1		Sitt ? Clay (0.0-2.0)		moist	0.0 H=0.0 S=0.0 H=0.0
10	15 25	2.0	1447	STATE	JERY STIFF		1		1	0.0 = N 0.0 = S
	20 55	1.3/	11100	CLAY	7		Sitticlay T-sand(0.0-0.6)	ML	Moist	0.0°H 0.0°S
12	63 65/4#	1.9	1458	TELL 11.9'	DANSE	1	Silt & Sand (Fm), Some Gravel (0,6-13)	GM	COMPACT 9V8-ANGUCARL SVB-RANGED GRAGE	2 S=00 H=0
			Amphibalite —	>	meo Hard	Gray	Roller but to 12.5' - Start Comy Rock			
14			(Cushing Formation)		~	7	Amphibilite - 70° Foliation Plane		(Hornbul / Seldspar	rich

TYPE OF DRILLING RIG: METHOD OF ADVANCING BORING: METHOD OF SOIL SAMPLING: METHOD OF ROCK CORING: **GROUNDWATER LEVELS:** OTHER OBSERVATIONS:

CME - 540 (ATV Drill Rig) Drive and Wash

Split Spoon (24" long X 3" ID)

HQ Wireline

BORING NO .: 58-QTY-O (A PAGE:

NOTES:

S= PEO Sciening H= Headspace PED

result (ppm)

OF 2

Tetra Tech, Inc.

BORING LOG FOR:	Former NASB - Quarry		BORING NO.:	NASB-SB-GRY-OLA
PROJECT NO.:	112G00645/112G02063		START DATE:	08/15/12
LOGGED BY:	B.Geringer	TRANSCRIBED BY:	COMPLETION: DATE:	08/16/12
DRILLED BY (Company/Driller):	East Coast Explorations / C. Palmer	The state of the s	MON. WELL NO.:	MW-GRY-OIA
GRD. SURFACE ELEVATION:	110,50' MSL	ELEVATION FROM: NAND 88	CHECKED BY:	

DEPTH	BLOW	SAMP	SAMPLING	DEPTH	SOIL		Single and supplied to the property of the pro	(ds) (L - # 4/87) =	STATES TO BE A STATE OF THE STA	
(FEET)	S PER 6"	REC. / SAMP LENG.	TIME & SAMPLE NO. (QA/QC STATUS)	MAT'L CHG./ WELL PROF'L	DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
			CORERUN OI	=	MED	Gray	FF(0.0-0.2) 45° J (0.3-0.4) FF(0.5-0.6)		Fe Staining in all	
14			START! END!				FF(0.4-1.1) SHJ(1.3-1.6) FF(1.7-1.8)		Joints/factures, Rough	
7		3.8	RAD= 19%		1		SH5(2.1-2.2) SH5(2.5) FF(2.6-2.8)		LEST APPROX. OF WATER	20 GALLON
16		4.0	BROLEN		med soft		SHJ(3.2) - Weatherd rack on both sides of	Joint		SS .
H							SAA(0.0-1.7) - lithday change to	13.23	- Perile obscul	
13				18.21	>	\	Pegmetite at 1.7' - (Quartz/Feldsp	W)		
		5.0/	CORE RUN 02 (B/16/12)	Pognative	HARD	Brown	HJ(1.9) Fe Staining 1.7-2.0		LOST APPROS, 200 GALLONS OF WATER	
20		5.0	START: END:				my 2.0-2.7 Fe Stowny 2.7-4.5		TO FORMATION @	19.5 bgs
			Ra0 = 88%			Brown	SH5 (3.2,3413.6) FF (4.0-4.2)		Fe Staining , rough	
22			Blocky	EOB	>	Gray				
				ગ્ર.5'			Installed Monitory Well, Set Screen			
							13-18 baz			
					2858-94E-15	a Tabl				
					820					
			'- ne							

TYPE OF DRILLING RIG:	CME – 540 (ATV Drill Rig)		Tetra Tech, Inc	C.
METHOD OF ADVANCING BORING:	Drive and Wash			
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:		
METHOD OF ROCK CORING:	HQ Wireline			[ما
GROUNDWATER LEVELS:				
OTHER OBSERVATIONS:		BORING NO.:5%-QRT-01A	PAGE: 2	OF2

FF= Foliation Fracture

HJ= Horizontal Joint

J= Joint

BORING LOG FOR:	Former NASB - Quarry		BORING NO.:	58-984-01B
PROJECT NO.:	112G00645/112G02063		START DATE:	08/23/12
LOGGED BY:	B.Geringer	TRANSCRIBED BY:	COMPLETION: DATE:	08/23/12
DRILLED BY (Company/Driller):	East Coast Explorations / C. Palmer		MON. WELL NO.:	MW-QRY-OIB
GRD. SURFACE ELEVATION:	110,37' MSL	ELEVATION FROM: NAVD 88	CHECKED BY:	

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS, or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
			1430				Drive I wash casing to top of Rock			
	2100		1530			-TW - 1	REACH TOP OF ROCK (8.5' bgs)			
			CORB ROW OF START BND 1537 1600	TOP OF ROCK 8.5'						
		30/	ROD= 58%	8.5	MED	Gray	Amphibolite - 70° Foliation		-hombing / Feldsper	
10		4.0	Broken		1	1	FF (0.3-0.5) FF (0.65-025), Rough	9	Festaining	
							FF/135-16) highly lacather 1		COST APPROX.	
12							FF (2.8-30). Mineral Infilling		OF WATER TO	FORMATION
		7	Core Run 62				FF (2.8-30), Mineral infilling FF/SHJ (0.9-1.5), Fe standing Rough		- Sonne garnet	
14			1607 1630				FF(2.2-2.6) SH5(2.6-2.9)		obsend	
		5.4	Rad= 50%				FF(3:2-3:6) Minen!	Ų.	LOST APP. GALLONS	of 25 OF WATER
16		5.0	BROKEN		V	V	SHJ (4.9-5.1) sharing SHJ(5.3-5.4)		Starting to transition	to Decuetile
		/	CORE RUN 03	_	HARD	Brown	545/V5(0.0-0.4) V5(0.4-0.9) \$45 (0.9+10)	Iron Stand - Pegund	
18	CONTRACTOR		SIART 2ND	1		1	SH5 (2.3 2.6)		(Fadsper	
		6.4	RQD= 72%	A . D	V	White	Changel back to Amphibolite at = 21 by	>	LOST APP	
90		5.0	Broken		HAPD	Gray	L		GALCONS TO F	OF WATER DRMATE DOV

TYPE OF DRILLING RIG:	CME – 540 (ATV Drill Rig)		Tetra Tech, Inc.
METHOD OF ADVANCING BORING:	Drive and Wash		
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:	
METHOD OF ROCK CORING:	HQ Wireline		
GROUNDWATER LEVELS:	~ 20' bgs		
OTHER OBSERVATIONS:	WELL LOCATED APPROX. 10' WEST OF MW-QRY-OIA	BORING NO.: 58-QR1-01B	PAGE: OF A

FF= Foliation Fracture V3: Vertical Joint

SHJ= Sub-horizontal ToinT

PROJEC LOGGE DRILLE	D BY: D BY (Con	R: npany/Drille ELEVATION		02063	Palmer	_	TRANSCRIBED BY:	BORING NO. START DATE COMPLETIO MON. WELL CHECKED B	08/23/13 N: DATE: 08/23/13 NO.: MW-QRY	
DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
22					HARD	Gray	FF(3.5-3,6 1 3.6-3.7) Fe Staining	s, Rough		
24			CORE RUN 64 (8/23/12) START: END: 08/3 08/3		HARD	White	FF(0.5-0.7), Fe Staining, rough Pegmatite intrustin (Quartz) (1.1-1	3	Ü	
26		3.2	RGD=79% MASSIVE		MED HARD	Gray	FF/SHJ (2.3-2.7), very weathere	1	LOST 150 GALLONS OF WATER TO FORMATION	
			111135346	30 3'			rock in zone, Fe Staining, 1006h		TORMAISON	
28				₹6.0°	*	-V	Installed monitoring well, Set Screen	^		
					50°.					
	Alcale -	/								

TYPE OF DRILLING RIG:	ICING BORING: Drive and Wash AMPLING: Split Spoon (24* long X 3* ID) CORING: HQ Wireline VELS: \$20 b33			
METHOD OF ADVANCING BORING:	Drive and Wash			
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:		
METHOD OF ROCK CORING:	HQ Wireline			
GROUNDWATER LEVELS:	2 20 bas			
OTHER OBSERVATIONS:		BORING NO.: 5B-QRY-018	PAGE: 2. C	of D

PROJECT NO .:

112G00645/112G02063

LOGGED BY:

B.Geringer

DRILLED BY (Company/Driller): East Coast Explorations / C. Palmer

GRD. SURFACE ELEVATION: 102.82' MSL

TRANSCRIBED BY:

ELEVATION FROM: NAUD 88

BORING NO.:

START DATE:

COMPLETION: DATE:

MON. WELL NO .: CHECKED BY:

5B-GET-07 08/20/12 08/20/12 MW-QRY-02

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
1	14	15/20	6937	FELL	Med. Dense	Brown B	Sand(=-w), little grant, T-sitt(0,0-0,0)		Dry Rooks	S=0.0 H=0.0 S=0.0 H=0.0
_a	12	1.3	0944			Brown	Sand(F), Some Silt (0.4-1.5) Sand(Form Silt : Granl (0.0-0.7)	SM	Dry Shey	5=0.0H=0.1 5=0.0 H=0.0 5=0.0 H=0.0
ų	14	1.2/	0147			Brown	Sandfam) : Grant, little Silt (0-7-1.3)	GP	woist .	2-00H-000 2-00 H-00 2-00 H-000
Ĝ	10	1.2	1025	SAND		j	SAA(0,0-03) Sand(F-m) T-Silt(03-1.2)	SP	L	0,0=HQ.0=2 Q.Q=HQ.0=2
8	21 25 57 50/0	1.2	1035	75	Dense	Boun/	SAA - (0.0 - 0.4) Sand(F), Some Sitt, T-Grave 0.4-1.0)	S'M	Moist (1.8-1.2) Weather	8:00H20,0 8:00H20,0
0	50/0	/	Report of 7.5' Corb run o l Street end	Amphibe- lite	Med. Hard	Gray	Amphibolite - 70° Schools Plane	JM	Rollur bit to 8'	\$>0.0H20D
10		4.6	1108 1146				FF (0.15-0.3), Smooth FF (2.5-2.9) Fe Staining, rough		" horbil / Seldspu LOST APPROP. \$60	rnch
12		5.0	Rad= 80% Massive				SH5 (4.0) Fe Stains, rough		TO FORMATION 44 125	
14							SHJ (1.2,1.35,1.6,1.8;1.9) Te Shaw			
16			CORE RUN DE START END 1420 1448	黑	7		NJ (1.2-1.3 } 1.4-1.6 1.9-20) \$\ferians		cost approp 300 Gallons of United To Formations	

TYPE OF DRILLING RIG: •	CME – 540 (ATV Drill Rig)	5= pid Screening 15	Tetra Tech, Inc.
METHOD OF ADVANCING BORING:	Drive and Wash	H= pid headspace	
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES: result (ppm)	
METHOD OF ROCK CORING:	HQ Wireline	= ····································	
GROUNDWATER LEVELS:	≈ 13° bqs		
OTHER OBSERVATIONS:	Shell Fragments not native, Shells observed in adjacent tock spoil Pile	BORING NO.: 58-024-02	PAGE: OF 2

FF= Foliation Fracture

- location appears to be old roadway SHIS = Sub-horizontal Joint

VJ = Vertical Toint

BORING LOG FOR:	Former NASB - Quarry		BORING NO.:	SB-QRT-02
PROJECT NO.:	112G00645/112G02063		START DATE:	08/20/12
LOGGED BY:	B.Geringer	TRANSCRIBED BY:	COMPLETION: DATE:	08/20/12
DRILLED BY (Company/Driller):			MON. WELL NO.:	MW-QRY-02
GRD. SURFACE ELEVATION:	103.83' MSL	ELEVATION FROM: NAID 88	CHECKED BY:	

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
1		4.0	Rad=67%		MED. HARD	Gray				
18		5.0	Broken				SHJ (4.0), Fe Staining, rough			
20	Le Tro			7			SHJ (4.0), Fe Staining, rough SHJ (2.0:2.3), Fe Staining, rough UJ (2.4-5.4), Fe Staining, rough			100
ao		54	CORE RUN 03 START END				(a.t. 5.1), to Starring, Turch		LOST APPROXIMENCY 300 GALLONG OF	
22		4.0	1500 1535		1	V	V		WATER TO FORMATION	
			RQD= 33%	E88			Installed Monitoring Well, Set Screen 12-22' bgs			
		/	Broken	ad			Screen 12-22' bgs			
								i i		
									# 1	
				- A T E						
				, * E.						
		/								
	ISI VE			15						

TYPE OF DRILLING RIG:	CME – 540 (ATV Drill Rig)		Tetra Tech, Inc.
METHOD OF ADVANCING BORING:	Drive and Wash		
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:	
METHOD OF ROCK CORING:	HQ Wireline		
GROUNDWATER LEVELS:	3 13' bas		
OTHER OBSERVATIONS:		BORING NO.: 58-ቂርኒ-ር	2 PAGE: 2 OF 2

PROJECT NO .:

112G00645/112G02063

LOGGED BY:

DRILLED BY (Company/Driller): East Coast Explorations / C. Palmer GRD. SURFACE ELEVATION: 92.81 'MSL

B.Geringer

ELEVATION FROM: NAVD.88

TRANSCRIBED BY:

BORING NO.:

START DATE:

COMPLETION: DATE: MON. WELL NO.:

03/21/12 03/21/12 MW-QFY-03

SB-024-03

CHECKED BY:

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]			
	5	2.0/		TOPSELL	Loose	Dr. Bens	Sand (5-m), T-Silf: Game (0.0-1.0)	SP	Moist roots	S=0.0 H=0.2 S=0.0 H=0.0			
2	15	2.0	6835	FILL	Me a Dense	Brown	Silt, T-clay(10-13) Sand (F-m), Some Gowel	GP	Doug	3:0.0 H :0.0:2			
	28	2.0			1	ET Brown	Sand (F-m), T-Sitt (0.0-2.0)	GW	Day	\$20,0 H20,0 \$20,0 H20,0			
4	31	2.0	0850		DENSE	BROWN	1	1	moist	520.0 H=0.0			
	18	1.4/			MED. DENSE	Brown	SAA (0.0 -1.4)			5=0,0 H=0,1 5=0,0 H=0.0			
6	28	/20	0919		DENSE	1	J.			5=00 H=0.3 5=00 H=0.4			
	13	1.4/		SAND	NOD DENSE		SAA(0.0-1.4)		Movest	5-0.0 H-0.7 5-0.0H-0.8			
8	16	2.0	0930		1	1	1		Wet Flakes	5=00115			
	13	1.7/	-0:0			Bown	SAA (0.0-1.7)		LOST APPROXI	S=Q DH=1.4			
10	20 22	2.0	0948		V	Gray	\psi		V TO FORMATION	S=0.0 H=1.6			
	5	1.5/	09.50	11'	LOOSE	91.4	SAA(0.0.0.8)		wet	5-20 HO,3			
12	4	2.0	0952	1	MED		Clay (0.8-1.5), Plastic	CL	Worst	520.0 H20.1			
	٦ 5	2.0/	V			Gray	SAA (0.0-2.0)			S=0.0 H200			
14	7	20	1010	CLAY			1			520.0 H20.0			
78 - 11	4	20/			1		SAA (0.0 - 2.0)			520.0420.0			
10	\$	20	0 1025	1 1026	1 1026	1 1026		STIFF	V	Dare Gray (1.2-2.0)	V	Shells	5200 H=0.0

TYPE OF DRILLING HIG:
METHOD OF ADVANCING BORING
METHOD OF SOIL SAMPLING:
METHOD OF ROCK CORING:
GROUNDWATER LEVELS:
OTHER OBSERVATIONS:

CME - 540 (ATV Drill Rig)			- E L W
Drive and Wash	80.5	31	
Split Spoon (24" long X 3" ID)			
HQ Wireline			
27'655		-111	

5=PID Streaming, H=PID headspace NOTES: Screening result



BORING NO.: 58-011-03

PAGE:

OF 2

BORING	LOG	FOR:
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PROJECT NO .:

112G00645/112G02063

LOGGED BY:

B.Geringer

DRILLED BY (Company/Driller): GRD. SURFACE ELEVATION:

East Coast Explorations / C. Palmer

92.81' MSL

TRANSCRIBED BY:

ELEVATION FROM: NAVD 88

BORING NO .:

START DATE:

MON. WELL NO .:

CHECKED BY:

COMPLETION: DATE:

08/21/12

03/21/12

MW-ARY-03

58-924-03

DEPTH **BLOW** SAMP SAMPLING DEPTH SOIL USCS REMARKS **FIELD** (FEET) S REC. TIME MAT'L DENSITY/ **MATERIAL** or (moisture condition; odors; **SCREENING** CLASSIFICATION PER CHG./ CONSIS. ROCK geological classification; DATA SAMP SAMPLE NO. WELL or ROCK CLR BRKN rock weathering; etc.) METHOD = LENG. (QA/QC STATUS) PROF'L HARD. FID, (PPM)] Dr. Gray STIFF SAA (0.0-1.7) MOIST CL 5:00 H:00 14 Shell 1032 15 2.0 18 Fryngts 5=0.0 H=0.0 5 MED Dr. Gray SAA (0.0-1.7) 5 5=0.0 Hao 1048 2.0 20 500 H200 14 Most Shell STIFF SAA (0.0-1.4) - More Plake 5=00 H=0.0 DK. Gray 1056 Francis 2.0 22 5=00 H=0.0 OK. 8.1 SAA (0,0-1.3) SOFT Pleste MOUST CLAY 5=0.0 H=00 2 1115 24 2.0 5:00 H=0.0 ugry Soft MOH OK. moist smil - Plastic 2.0 SAA(0.0-2.0) 5=00 H=0,0 1123 Fraguets 20 SOOD HOD SOFT 26 3 SAA(0.0-1.6) - Plushe 6 520.0 H20.0 33 1130 8.0 52 00 420.0 28 WOR VERY Br. Moist SAA (0.0-2.0) 5:0.0 H20.0 20 SOFT 1220 2.0 S=0.0 H=20 30 GP most/uet - Rock WOR STOPF Dr. Gray SAA(0.0-0.2) SEAD(5-10), T-5iH(0.3-10) 1.0 31' 5=0.0H=0.0 6 1235 90/0 508 32 Install MW - Set Screen 5.5-10.5 bas (ROCK)

TYPE OF DRILLING RIG:	CME – 540 (ATV Drill Rig)		Tetra Tech, Inc.
METHOD OF ADVANCING BORING:	Drive and Wash		
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:	
METHOD OF ROCK CORING:	HQ Wireline		
GROUNDWATER LEVELS:	≈ 7' bas		
OTHER OBSERVATIONS:		BORING NO.: 58-QFT-03	PAGE: 3 OF 2

BORING L	OG FOR:
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PROJECT NO .:

112G00645/112G02063

LOGGED BY:

B.Geringer

DRILLED BY (Company/Driller): East Coast Explorations / C. Palmer

GRD. SURFACE ELEVATION: 94.40' MSE

TRANSCRIBED BY:

ELEVATION FROM: NAVD 88

BORING NO .: NASB - SB-GRY-04

START DATE:

08/21/12

COMPLETION: DATE:

08/22/12 MW-024-04

MON. WELL NO.: CHECKED BY:

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
	3 3	1.5	1502	TOPSEEL	1005E	DK. Brown	Sand (5-c), Little Grant, 7-514 (0.3-1.5)	SM GP		\$=0.0 H=0.1 \$=0.0 H=0.0 \$=0.0 H=0.3
a	3 3	30/			7.15.	Brown	5and (F-c), Som gran (0.0-1.1)		Chunes	\$200 H20.3 \$200 H20.1 \$200 H20.1
4	3	2.0	1510	FILL	1	Dre. Bountage	5:1+2 Sh. (F), T-Gran 1, mod churts (1.1-2.0)	5M		5:0.0 H2 O.D
	395	0.5	1526		LOOSE		(0.0-0.5) SAA, Rece of Copper wine			5=0.0 H=0.0 S=0.0 H=0.1
(e	17/3 ⁴ 50/0	0.0		6.25	MOD	Gray	Rock in the - Amphibolite, 70° Foliati	× ×	LOST 200 GALLONS	10-H 0018
8		0.25		I			FF(0.25-0.4) FF(0.5-0.7) Fe Staining	×.		2.5
10		25/	CORP RUNO (B 22 12) START END 0807 0825				UJ (0.7-0.9) FF (1.1-1.2) FF (1.5-17) stown RON 02- NO Fractus Observed		Rock very boins - - hombland / felds	per nul
		1.5	Rao = 0%						LOST 100 6AUGUS	
ia		1.5	Broven)33% Core runo?				See Page ## 2 For care run #3			
13		\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	START ENTO							
			RQ0=100% MASSDIE		1	V				

TYPE OF DRILLING RIG:
METHOD OF ADVANCING BORING
METHOD OF SOIL SAMPLING:
METHOD OF ROCK CORING:
GROUNDWATER LEVELS:
OTHER OBSERVATIONS:

CME - 540 (ATV Drill Rig)	
Drive and Wash	
Split Spoon (24" long X 3" ID)	
HQ Wireline	
5.2' 693	

S= PID Screening result, H= PID NOTES: headspace result (PPM)

BORING NO.: SB-QRY-04

Tetra Tech, Inc. PAGE: OF 3

FF = Foliation Fractive UJ = vertical Joint SHJ = Sub-honzartal Joint

BORING LOG FOR: Former NASB - Quarry BORING NO .: NAS-SB-G2+-04 PROJECT NO .: START DATE: 112G00645/112G02063 08/21/12 LOGGED BY: TRANSCRIBED BY: 08/22/12 B.Geringer COMPLETION: DATE: DRILLED BY (Company/Driller): East Coast Explorations / C. Palmer MON. WELL NO.: MW-924-04 GRD. SURFACE ELEVATION: 94.46 MSL ELEVATION FROM: NAVD 88 CHECKED BY:

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
			Core eun 03 Start end		med Hard	Gray	5AA- Pesmitic van (0,6-0.3)			
12			0950 1005							
14		5.0	Rad 45% Massive						LOST 150 GAUGUS OF WATER & ZUTO FORMATION	
			, , , , , , , , , , , , , , , , , , ,				70°5 (4.2-4.4), Fe Staining			
16										
			CORPRUM OF						of water to	
19			1020 1043						FORMITTON	
		5.0	RUD = 108%				SHJ (2.8), Fe SHORMY			
20		5.0	MASSIVE							
							SAA- NO Fractus observe		LOST LOO GALLES	
22									of water to	- 1 - 1
			CORE RUN OF							
24			91ART 600							
26		5.9	RQD=100% MASTLE		\ \	V				

TYPE OF DRILLING RIG:	CME – 540 (ATV Drill Rig)		Tetra Tech, Inc.
METHOD OF ADVANCING BORING:	Drive and Wash		
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:	
METHOD OF ROCK CORING:	HQ Wireline		
GROUNDWATER LEVELS:	5.2' b45		
OTHER OBSERVATIONS:		BORING NO.: \$3-QRT-04	PAGE: A OF 3

BORING	BORING LOG FOR:		Former NASB -	Quarry			BORING NO.: NASE	- 58-924-04
PROJEC	T NO.:		112G00645/1120	G02063			START DATE:	08/21/12
LOGGE	LOGGED BY: DBILLED BY (Company/Driller		B.Geringer			TRANSCRIBED BY:	COMPLETION: DATE:	08/22/12
DRILLED BY (Company/Driller		pany/Driller):	East Coast Explo	orations / C. P	almer		MON. WELL NO.:	MW-QRY-04
GRD. SU	GRD. SURFACE ELEVATION:		N: 94,46' MSL			ELEVATION FROM: NAUD 88	CHECKED BY:	
							estant de etá fasorarel no Si	
DEPTH	BLOW	SAMP	SAMPLING	DEPTH	SOIL	walls of the the thousand the tree through the tree of	USCS R	EMARKS FIELD

DEPTH (FEET)	BLOW S PER 6"	SAMP REC. / SAMP LENG.	SAMPLING TIME & SAMPLE NO. (QA/QC STATUS)	DEPTH MAT'L CHG./ WELL PROF'L	SOIL DENSITY/ CONSIS. or ROCK HARD.	CLR	MATERIAL CLASSIFICATION	USCS or ROCK BRKN	REMARKS (moisture condition; odors; geological classification; rock weathering; etc.)	FIELD SCREENING DATA METHOD = [FID, (PPM)]
28			CORE RUNGE START END 1135 1149		MED. HARD	Gray	No Freches obsert			
30		4.1 4.1	THE LIFE OF STREET	30,5		U	V		COST APPLOY 100 GALLOUS TO EDILUTES	
				808		16271	Set well Screen at 8-16	# 2		W. S.
							c			
w i										
				3°, ≥ = 1						

TYPE OF DRILLING RIG:	CME - 540 (ATV Drill Rig)		Tetra Tech, Inc.
METHOD OF ADVANCING BORING:	Drive and Wash		
METHOD OF SOIL SAMPLING:	Split Spoon (24" long X 3" ID)	NOTES:	
METHOD OF ROCK CORING:	HQ Wireline		
GROUNDWATER LEVELS:	5.2' bgs - Pumpel to Gallons, dear water land dom to 6' bgs		
OTHER OBSERVATIONS:		BORING NO.: 58-997-04	PAGE: 3 OF3

HQ Core

Converted to Well:

Yes

No

BORING LOG

Page of 1

PROJECT NAME: Quarry / NASB MW-QRY-05 BORING No.: 112G02063 10-29-13 PROJECT NUMBER: DATE: DRILLING COMPANY: Fust loast Exploration **GEOLOGIST:** T. Buaus **DRILLING RIG:** DRILLER: MATERIAL DESCRIPTION PID/FID Reading (ppm) Lithology Sample Depth Blows Sample No. and (FL) Recovery Change 6" or S RQD (Depth/Pt.) Soil Density/ Type or OF C RQD Run Sample Consistency (%) or Remarks Screened Color No. Length **Material Classification** Rock Interval Hardness 0 140 15m Bm 5-2 0 1417 0 1427 Rollerbit Sand w/plants/wood so 0.2-2 Wood THEM BR 1545 49 subvert fro 5.0 DE 4.7 (2) 1555 - 1605 AN 4 5,0 5.0 Lose NISUGAL @ beginning of @D W/pinh 10/30 0820-09 No water weter <same tt, o return > Broken 15.5-16.0 (Helpar) 0805 WC= ~518 VBF @ 1000 -16tz BL Loss-200 gal cwath reture 18'> High Biotice 17.5 1180_1125 12 two 62 6 18.2 \$ 18: BR 20 TD=19.5 1140 Set Well 2"PUC 10-510+ 9.0- 19.0 7.0- 19.5 30-70 * When rock coring, enter rock brokeness. ** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read. **Drilling Area** Remarks: 100 & Rad clearance 0 to 5.7 Background (ppm): 0,0 6.0-19.5 5.7 to 6.0 (1440-1455) Drive & wash

Well I.D. #: NW -QRY-05

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BORING LOG

Page 1 of 2

Time I'm

MW-QRY-06 PROJECT NAME: Quarry / NASB BORING No.: 112G02063 PROJECT NUMBER: 10/30/13 DATE: DRILLING COMPANY: Fast Gast Exploration T. Evans **GEOLOGIST: DRILLING RIG:** DRILLER: - Palmer STO ATV MATERIAL DESCRIPTION PiD FID Reading (ppm) Lithology Sample Depth Blows Sample U No. and (Ft.) 6" or Recover Change S (Depth/Ft.) RQD Soil Density Type or or 1 C ROD Run (%) Sample Consistency OF Remarks Color S 82 No. Length Screened **Material Classification** Rock Interval Hardness 13/30 דט ף ביון 5-1 1425 c sand Dy Blk 0 F-CSO-d & Roch 1431- Natik FSad \$5:1+ 5-2 0 F Sad Soulif Dy 0 0.1/0.5111 = 11 -No re covey - nod 5-3 1442 Dk BL 1526-1549 553 - 1600 1000/ HIX FORCE 6.8 @ 23 7.41 @ 81 BR 10/31 b OK Grean VBr @ 0017-0834 Amphibolite Hi & Fruce 10' (Stalling Br (3) 0846-0910 Hi 4 Frac @ 12.9 w/strivery 100% (3) 14.3 15.3 Hi Frac w/wud 13.7 DK Gm 100% @ 0920-0940 M 50/ 4 150 HI & Frac @ 19.5 (foliat Br 70 SUS HOVERE @ 2018 - mi HATTOCE 215 (folia he BR 0K (contact @ ~221) 0955-1005 Grano Cels (High BiotiA) Some Hadlass weathered Bruj 1100 - 1110 Phlog opite When rock coring, enter rock brokeness.

	The state of the s	A CONTRACTOR OF THE PARTY OF TH	THE PERSON NAMED IN COLUMN TWO IS NOT THE OWNER.	ency if elevated reponse read.	Background (ppm):	
Tremains.	" COT	2 16 T		Inke wesh o	Background (ppin). S	
- 2	10 000	0 4-	, Hoo c	ALLICE A COLLEGE	+3 7/3	
Converted to We	eli: Ye	es V	No	Well I.D. #:	MW-QRY-06	
						-



BORING LOG

Page 2 of 2

PRO	FCT	NAME NUME COMP RIG:	FR.	Quarry / NASB BORING No.: 112G02063 DATE: GEOLOGIST: CME 550 ATV DRILLER:					MW-QRY 10/31/13 T. Evan C. Palmer			1	
2.75							RIAL DESCRIPTION			PID/FI	D Rea	ding ((ppm
Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S	Remarks	Sample	Headspace	Borehole**	BZ**
749	1	X		\sim	BA		multiple hor. +		Little the return				
1		X		7	V		multiple hor. \$ hi & Frac througho	A					
				10=									
		/		26,5					1120-1205 Allow	W	ate	~	か
	30								equili	9 n	+	•	
									1205 +225 Punge	@	Y	91	olen
								5 10 6 6	W1= 70.61 (1	50 T 4	, 5	9	al
							1		1225 WL= 20,6	15	55		
		/							1230 WL= 18.0		95		
						college.	The Many of the Ma		1248 WL= 17,45	1			
		/					2" euc 10-510+ 16-	26	1250 Set wel	9			,
		4					ØS Sand 14.0:						Q.
							Bentrite 35-	14.0					
									1520 Denob		2013		
						N.							
								100					
									* 1				
						100 d							6
					(n=0.00)	B S						1501 571.5	
	monito	43-4-0-0345-0	rock brok in 6 foot		borehole. In	crease	reading frequency if elevated repon	se read.	Drillin Background				



Converted to Well:

Page 1 of 2

												W	M
		NAME			Ty / NAS	В	BORING N	10.:	MM-GRY-	0	7_		9
THE PARTY OF THE	Thomas and	NUME			602063	Þ	DATE: GEOLOGI	OT.	11-4-13				
DRIL			ANT.	East	- Coas-	0	ATV GEOLOGI DRILLER:	Ο Ι.	T. Palner	-			
	and the				-	ATE	RIAL DESCRIPTION	1		PIDAFI	D Par	odina	=
Sample	Depth	Blows /	Sample	Lithology			MAL DECOMPTION	U			T		ppi
No. and Type or	(Ft.)	6" or RQD	Recovery /	(Depth/Ft.)	Soil Density/			S					
RQD	Run No.	(%)	Sample Length	or Screened	Consistency	Color	Material Classification	C	Remarks	Sample	leadspace	Borehole**	B7**
				Interval	Rock Hardness					Sar	lead	Bore	8
	9						,		Time				
5-1		1/2	1.5		Stiff	DILBY	n topsoi / Huric	OH	0957 UMOIST	0	2.3	-	0
71	7 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	4	2.0		71114	Gray	Sitt Fr-Sove FSand	NL	a all 1 10	8.8	5.6		2
5-7		7/0			111	FENET	oll 10 some 1 some	_		0	29		H
9 7		31	1.6/		Havu	Gry	Silt/Clay Tr Sand	my	1005 (5/204)	0	39		H
		150	2.0			Bry	(Hard)	CL	Mothed	٥	0.9		Ц
5-3	2	43	1.0/		Hava	Gry	Clay Jr Sitt	(L	1035 (Spage)	-	-		
		1822	2.0			BM				00	1.18		1
54		20/30	2.0/		Hard	Cores	clay Tomsane Silt	CY	1045 Wet	0	16		1
	N. W	37/-	120			Bru		Vac	Sample Pap	_	7.4		D
5-5		10/	70,		Hard	1		11		0	9.7		C
3 3	10	20	2.0		(In o			#	Sample Days ag	0	10		1
<i>c i</i>	[0	10 74	HICKLINES		a.C.	,	, privar	1		0	0.6		Н
5-6		10	2.3/	_	ustft	Blue	V FSand Zue	U/	115	0	10		H
	134	199	2.0			Gray	Clay Trilt ics	CH	hoist	0	10		Ц
5-7		45	1-3				Clay Tr Rock Frag	CH	1125 U MOISH	0	0.8		9
		20/3/	1.3	川三川	je :	6	Treit			0	0.6	100	
	15			Call	BR	DK	Biothe Rich (this	the	(1) 1245-1320	ķ			
0.51	1		33	~	District Conference of	ray	granofels "	1					
135	\cup		3.5			+01	A 1 1 1 7 a						
	IV			7	13	KGN	Simple that a little of the control)			1	
A .	_	4		E		DK	Biother Rich		@1737- HUO		22 -		
94%	(2)	4	50			Gray	Grantels (Hi & Alic	me				alle.	10
47	29	1	5.0	1									
(20)	floor I	\mathcal{A}		1				100					
		X		1								Tie	
		*	SE I	4	Fig. 34		Birtie Otz Dil		3) 1415-1435				
1886	3		50,	+			Biotite at 2 hich Granofels	DR.		-	10		
7-010	7		15.0				-1. 0.0400		Some Haplass	104	7	uh	
10//	92		rock brok	4		MANUE			(10-20 66)			2.0	
** Include	e monito	or reading	in 6 foot	intervals @	borehole. In	crease	reading frequency if elevated reponse r	ead.	Drillir	ng A	rea		
Rema	rks:	UX	OC	leava	nce	0	+06'		Background	(pp	m):	L	2

Well I.D. #: MW-QRY- 07



Page 2 of 2

	D4	g et Meser		114	N	ATE	RIAL DESCRIPTION		t. Evals e. Palmer	PID/FID Reading (ppn					
Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	S C S ·	Remarks	Sample	Headspace	Borehole**	D7**		
	0-)	V		F											
		1		1						1116			t		
		/		1	TD=27	14									
		$\overline{}$							1445 - Pup BH		2	09			
	30	/				alizini				21	1_	0	F		
		$\overline{}$							1535 WL= 8	18	n	SA	Ļ		
		/											2		
							2"PVC 10-510+ 17-2	7	15to Stwell				Γ		
	37.5		(45) = 1 -		9		05 Sand 15-27	100							
	40					32 H	Bertonile 3-15								
		/							fundamental and the state of th						
		/										94			
		4													
		/													
										ij.					
		4													
		/	4 14								N/A				
		4	M I I										The same		
		\leq													
							/			1380					
					ii ii								S.		
-															
7													4		
8.81	L	ng, enter									Ser.		0.1		



TETRATECH BORING LOG

Page _ / of _ /

PROJECT NAME: PROJECT NUMBER:

Quarry / NASB 112G02063

DRILLING RIG:

112G02063

112G02063

East Coast Explantion

CME 552 ATV

BORING No.:

MW-QRY-08

DATE: 11-5-

GEOLOGIST: T. Evans
DRILLER: C. Palmer

					N	IATE	RIAL DESCRIPTION	M		PIDA	D Rea	ding (ppm
Sample No. and Type or RQD	Depth (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	Sample	Headspace	Borehole**	Z8
5-1		3/3	04/		Moense	Brn	Topsail	OL	0937	O	οН	1	á
		6/3				10 ×	F Sand I Dry Silt Tr Sand	SP		0	0.9	-	1
5-2		10/28	1:8/		V Dense	Bu	silf Tranc	ML	09 45	0	0-8		T
		2578	12.0				Silfy said & J	Sw	4	30	03	,	1
2-3	5	52/311	013/00	गाना	V Deuxc	82%	Sitty Sand (Roch) Days	1.3	0955		1.1		t
				-					Rollerhitt to 6.0	1			
	(1)	X		石子	. VBR		Brothe-Mil Schist				11		
2.01	0	X	1/2	1		Grad	Brothe-Mid Schist	SU	rfices	The state of		a. In	
15.0		X	5.	1	1	1	to 9' (high X +	Pro	ces)				
(40%)	10	X		4	BR		frais offices this to	5.)	Maguely Land				
		K		17/2	1								
	~	X		W.	BR		Otz-Pich Granofels (filinted) situat frace 11.4- HAFRICE 13'						
4.4	(2)		47				(Clinted)		(2) 1125 - 1150				
4.7		4	5.0	H			subject frace 11.4-	- 12	4				
	12	4	i in	1	V		HAFRIP 13'	Bat.					
		X		1	BL	J	(Brechiated 15-16)						
5/		X	4.5		W	Gray	Oct 2 Rich Grows fet		(3) 1205 - 1220	***			
45	3	4	40			1	(Breciated)						
(06°A)	4	1,0				Log Frace 17'			100			2
	90			111	V	V		1	WL=10:3				
7 4 4		/		T0=20	,′		Cavelato 18,9'		1250 - Pump B	μ.	~	5	al
		/			14	15	set well.		1 (to 60.	llo	1	1	
		4					211 PUC Slot 6.5-165	/		16	-	-1	
		/					OS Sand 5.5-18.	JESSON-11	1312 WL=1	Mark Control		′	
	35		rock brok				Bentonte 3.0-5.	5	1335 WL= 1	670	Second .		

0	All and the last of the last o	AND THE RESERVE OF THE PARTY OF		2	The state of the		-10	in the state of th		A STATE OF THE PARTY OF THE PAR
* When rock cori	ng, enter rock br	okeness.						1410 W	L= 6.X'	
** Include monito	or reading in 6 fo				frequency if	elevated rep	oonse read.		Drilling Area	
Remarks:	1)x0	Clean	ance	0+	0 6	1		Back	(ground (ppm):	Ø
	Location	~ rpoc	ated	NZO	15W	from ,	Pro Pased	l due to	wetarl	9 3
1	2" 50	T 0 to	4.31	HW	Casing	U 15'	4.31	HQ C	ore 5.0 to	
Converted t	o Well:	Yes		No	0	W	ell I.D. #:	MW-	0R4-08	



DRILLING RIG:

BORING LOG

Page ___ of _2

PROJECT NAME: Quarry / NASB 112G02063 PROJECT NUMBER:

DRILLING COMPANY: Dast Coat Exploration CME 550 ATV

MW-QRY-09 BORING No.:

DATE: **GEOLOGIST:** DRILLER: Palmer

Sample	Donth	Blows /	Sample	Lithology	N	MATERIAL DESCRIPTION			U		PIDIND Reading (ppm				
No. and Type or RQD	Depth (FL) or Run No.	RQD (%)	Recovery / Sample Length	Change	Soil Density/ Consistency or Rock Hardness	Consistency or Color Rock Hardness			Remarks		Headspace		#Z8		
5-1		2/3	20		Loose	OK	Topsoil/vegetitue	OL	0845	8	0.5		0		
		44	2.0			Tan	Frank On-Op	50		00	2.5				
5-2		5/2	1.6/	, ,	Mohr	-	trmica	1	9850	C	4.4				
	25-77	8/10	123							OC	12				
5-3	5	69	0.7	, ;	n Dense		Danp		0910	-	-				
		10/0	20	-						0	09				
5-4		10/1	1.1		Mong				09 20	-	5:(
		(3	20				wete tip			9	23				
5-5			0.90	- 3	Manse			1	0435	0	16				
	10	10/5	20	==		4	mica-Rich win tops	100	tia i	Ø	p.7				
5-6	34113	8	1.21	12 :	Moone		F Sand wet	26	0947	0	14				
		10/	120	7 1		Bru	Tritte	1		9	19				
S-7		6/3	10/	H		^	1	4	1002	0	1.9				
		13	20	111	STIFF		Clay Tr-Sue Sil+	CL	nottled Dage	0	18	 			
5-8	15	8	1,4		NSASA	olde	Clay Tr-Sue Silt	CL	1022 Days	0	2.3				
		10/2	20				~			0	13				
59		8	1.1/		1 Stite	Olike	Clay Tr Silt	CL	1030 Day	0	45				
		215	2.0				10 Tr Shell			0	2.2	-			
			2.0/			DIO									
5-10	- Version	16				1200-	Clay Tr Shell	0-	1045 Dag	0	2,2	,			
		16 20	2.3			42	o Just 14			0	2.2	- '			
		/		714						1			Ø		
		4		11						,	100	3	4		
- 11	7,	1			- C'''	Rhe	CII OI to	0					9		
5-11	25	73	/		MSTIFF	gry	Silty Clay theil	CH	1153 Moist	Ø	09		0		

* When rock cor	ing, enter rock	brokeness.						
** Include monito	or reading in 6	foot intervals	@ borehole. In	crease readin	g frequency i	f elevated reponse read.	, Drilling Area	
Remarks:	2115	PT	0 %	33.5	HW	Cash 0 to 14	Background (ppm): Ø	٦
	UXO	Cleare						
	3"\$	roller	sit 14	to 33.	5/4	1 3" casing to		
Converted	to Well:	Yes	V	No		Well I.D. #: /	nw- QRY-09	



Converted to Well:

Yes

PRO.	ECT ING	NAME NUME COMP RIG:	BER:	1120 East	Ty / NAS 602063 Cast 1	i ola	BORING N DATE: GEOLOGIS DRILLER:	lo.: ST:	MW-QRY-09 11-6-13 Ti Evans C- Palmer						
					N.	IATE	RIAL DESCRIPTION			PIDI			(ppn		
Sample No. and Type or RQD	Openth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soli Density/ Consistency or Rock Hardness	Color	Material Classification	U & C & *	Remarks	Sample	Headspace	Borehole**	BZ**		
		34								Ø	8.9		C		
8															
C 12		Wall of	20,		V Soft	Blue	01 007	0.4	124/						
2-15	30	MOH	2.0		VJat	Bud	Clayer Silt	(A fi	1205	00	21		S		
		Z		· 32.5					3' Melented +	1 1125					
0 10		4		35.3			TILL 1325-37.5			-			0		
S-B	35	50	6"	14214			ENB @ 37.51		1250	-			93		
	37						Bentonite Play		1300						
		\angle					14.0-33.5								
	*						Set well		1310	+					
	40	\geq		6.5= 50.1			2"PVC 10-510+ 6-13"	1					1073		
							Sand (\$5) 5-14								
				1			Bentante 3-5			Yes at			-		
												100			
	45	\angle	Tara 7	ř											
		4										2			
			!	21											
100		\angle													
	50												N. 8 50 S		

No

Well I.D. #: nw- any-09



BORING LOG

Page ______ of ________

BORING No .: MW-QKY-(3 PROJECT NAME: Quarry / NASB PROJECT NUMBER: 112G02063 DATE: East Coast Explant on GEOLOGIST: DRILLING COMPANY: EUANS CME 550 ATV DRILLING RIG: DRILLER: PAGNEN MATERIAL DESCRIPTION PID/FID Reading (ppm) Depth Lithology Sample Sample U Change No. and (FL) 6" or Recovery S RQD (Depth/Ft.) Type or or Soil Density/ C RQD Run (%) Sample Consistency OF Remarks ...Z8 No. Length Screened Color **Material Classification** S OF Interval Rock Hardness 0 Time TOBOIT L008 0,0 5-1 1050 Fsand Trsil+ Dry 0,0 M Dense EDK BIN Silt/Fsand (0.1') 5-2 ich> 1100 ONO FSand Tr-Sitt Dry 5-3 Dehse 1135 5-4 tan Dense 1236 0.005 Brn 0,0 < NO sample 8-10 Driller Overdrilled 10 Zone> 5-5 F-C Sand Sove Silf GW 1250 Pamptan 0.21.5 Dense Some noch tracs Bon Moist Bru 5-6 V Dense M-c Sand 1325 Sandy Silt & F Gravel. Bru MOIST 0.0 0.7 111 = 111 17 Biotite -nich Grano Cels/Statues 1345 Purge 7 1405 WL= 11.11 415 Pune 2 20 2" PVC 10-slot 9-14 WL= 12.3 05 Sand 1510 WL=106 Bentonite 3-7 1600 WL=1013 1615 HW Casing to 14 set ualt * When rock coring, enter rock brokeness.

** Include moni	tor reading in	6 foot intervals (@ borehole. Inc	rease reading freq	uency if elevated reponse read.	Drilling Area
Remarks:	11x0	Clear	ance	0 +0 6	feet	Background (ppm):
	211	SPT	0 10	13,8'	HW Casing	0 to 14'
			Victoria de la compansión de la compansi		第二次 10 mm	
Converted	to Well:	Yes	V	No	Well I.D. #:	MW-QRY-10

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PID dying out

No

Well I.D. #: MW-QRY-11

Yes

Converted to Well:

BORING LOG

Page | of |

10

BORING No .: MW-QNY-11 PROJECT NAME: Quarry / NASB 112G02063 PROJECT NUMBER: 10-31-13 DATE: East Coast Exploration DRILLING COMPANY: GEOLOGIST: T- Evans **DRILLING RIG:** DRILLER: C. Palmer 5.10 ATV MATERIAL DESCRIPTION PID/FID Reading (ppm) Sample Depth Blows / Sample Lithology U No. and (Ft) 6" or Recovery Change S Type or RQD (Depth/Ft.) Soil Density/ or C RQD Run (%) Sample OF Consistency Remarks Screened Length or Color **Material Classification** S Interval Rock Hardness Tersoi - No debris line 1440 5-1 pose V Dense 5-2 1445 ΔΔ 1500 Drive HW CO A A 15/5 Rollerby Core 35-5 Dense Ban 1536 FM Sad 1547 Daup) 5-4 M Derke 1610 wet 1615 WL=6.71 1630 Breakdo 0745 WL=7.4 0845 Setwa 2" PVC 10-Slot 5.5-10,5 MS Sand 45-105 3.0-4 * When rock coring, enter rock brokeness. ** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read. **Drilling Area** Ulko Clearance O to 3,9' Background (ppm): Drive & wash the casing 0 to 10:5 due to humid it; head pace only 0 +010.5



Page ____ of ____

DRILI	LING	RIG.		C 10	G 73	0	GEOLOG DRILLER RIAL DESCRIPTION		Cipalm	Name and Address of the Owner, where		ding (p
Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	3 S C S *	Remarks Time	Sample	Headspace	Borehole**
<u>8-1</u>		68	14/2.0			Bra	F-M Sand Tr (Same Tr Rock Frags Damp	SP	1015	-	118	
		I IY	201			Card		THE RESERVE OF STREET		-	9.2	
2-2		42	0.8/12			Gray	F-(Sand and	SP	1025	-	1.0	
		50/2"		EUB			Roch Frags Wit					
	5	4								-		
3.0		/					Refusal @ 3.2	4	1			
Av.		4				4	uxo detecting "	net				
	100	/				A C	Relocate app	ruy	5 south			
		4										
		\leq		WT = T		11511						
		4										
	T O'AN	4										
		4	f Library							11 16		
		/										
		4										
		/	AT VE			H II.						
			1000									
g va												
											TAL	
				* 1								
	monito		rock broke in 6 foot i	ntervals @	borehole. In	crease	reading frequency if elevated reponse	read.	Drillii Background			



Page _/_ of _/_

DRILI DRILI		COMF RIG:	PANY:	EAS CM	6770	,	x planation	GEOLOGIS DRILLER:	ST:	10/28/ T. Fua C. Palm	us			
Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/FL) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	RIAL DESCRIP Material Class		U S C S *	Remarks	Sample	Headspace Headspace	Borehole**	BZ***
S-1	0	40	05,			Brn	F c	1		Time 648	A CO	短點		
2		10/3	20			ISTh	F-M Sa Tr Mod	force of		U 78	1			
		1		EOB			17 100	11093						
							Uxa dete	etim u	2	4-1		V		
	5					,	Uxo dete	ROPPY	10	I N-NE				
			TEN ST											
		/												
		4												
		4												
		4											基门	
		/							a de la constante de la consta					
	- 1	4				18								
											-			
	2 A.8					100 24 2 2 2					+) ^{II} /	
7 V=08														
											+			
	1/4											.=		
				Salamas. Ula es										0/00
	monito	or reading	rock broke in 6 foot i	ntervals @			reading frequency if el		ead.	Drilli Backgroun	ing A d (pp			7



Page <u>/</u> of <u>/</u>

DRILI			One Suit				GEO DRIL				PID/FI	D Rea	ding (p	_ pn
Sample No. and Type or RQD	Depth (FL) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	1	□ % C % *	Remarks	Sample	Headspace	Borehole**	BZ**
5-1	0	88	0.7/			Bru	Topsoil		01	1105	1	0.9		
		174	120			Brn	F Sand Tres	and	SW	pans Rock in shoe		1,3		
2-5		22/2	1.0/			Gray	f Sand Some Silf/	cleg	GM	1118		0.6	9	
		32/6	/20	2.3		PK	n' Broken Roce	he		spoor wet		1.7		
	5			EDB		•	(Amphibolite)						
						1	HW casing				1			
	i i						HW casing kicking off rock surface Relocate b	- 04						
							rock surface	ce						
	10.00					1	Relocate b	ove	ho	le				
							approx 6's	SW						
TU.								- 10	1					E
						// 2/ // 第0 // 由			1					
			diversity.					Lugaran						
Secretary.														
Amazi e Wehis									1008 H.O.D.					
														72
												7.0		N
													T	
						No. 1								
														ı
	monite	71	rock brok		- /		reading frequency if elevated re		ad.	Drillin Background				



BORING LOG

Page | of |

MW-QRY-12D Quarry / NASB BORING No.: PROJECT NAME: 112G02063 10/28/13 PROJECT NUMBER: DATE: T. Evans DRILLING COMPANY: East Coast Exploration GEOLOGIST: **DRILLING RIG:** C. Palmer DRILLER: CWE 220 PIDIFID Reading (ppm) MATERIAL DESCRIPTION Lithology Depth Blows / Sample Sample U Change No. and (Ft.) 6" or Recovery S (Depth/Ft.) Soil Density/ Type or RQD ROD or 1 C Run Sample (%) OF Consistency Remarks 82 No. Length Screened Color **Material Classification** S Interval Rock Hardness Time 1,1 5-1 F Sand Tr San 1310 6,1 Damp Sitt Sand Some Clay!
RWKen Rocks! Bright 5.0 1.0 5-2 Drive & wash the casing to L DK Amphibalite
minor peg 川三川 VBT 10 1446-1500 0% (2) 537-1624 Auphibalite
Minor oftz veins 100% (2) 1 Rod chatter @ Hi 4 Frac 5,9-6.2 10 10/29/13 Br B 0838 -093 60 4 Fre € 10.8 90% (3) 150 Hor-Subhor Free @ 13.0 12,5-13.0' SOF Subhor Frac @ 14.8 14.7-15.3' rodala Q 1035-1045 Her Frace 15:3 (stain Trr. Her Frace 15:9 15:3-16 'Soft 95% V 13 V Har Frac @ 16.8/6.9 17.3 4/Steller In 5 \$500 tal 20 NO Dra Z" Sch 40 loslot 7.3-17.3 Hollis ton 515-17.3 Rentonite 3,0 -* When rock coring, enter rock brokeness. ** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read. **Drilling Area** UXO & Rad Clearance 0-2,9' Back 2" SPT 0-2,9' HW Drive & was h U +0 4.3" Background (ppm): — Converted to Well: Yes Well I.D. #: MW-QFY-12 No

WELL CONSTRUCTION LOGS

WELL NO .: MW-QRY-OIA



	OCATION Former NASB	DRILLER C. Palmer
	ORING S8-GRY-OLA	DRILLING Drive ! Ha
DATE BEGUN 08/15/12 D	ATE COMPLETED 08/16/12	METHOD Wash / Wireline DEVELOPMENT NIA- Well Day
FIELD GEOLOGIST B. Geringer GROUND ELEVATION 110,50' D	SECUAN MUTA	DEVELOPMENT WAS WELL DAY METHOD WHALE POMP B
GROOND ELEVATION HOISE	ATOM_NAUDBE	WEITIOD DOWNER OF
•	ELEVATION/HEIGHT OF TOP OF	SURFACE CASING: 113.15/ 2.65
	ELEVATION/HEIGHT TOP OF RIS	SER: 113.07/ 2.57
	TYPE OF SURFACE SEAL: Cor	ncrete
	I.D. OF SURFACE CASING:	<u>" </u>
	(5' long)	
	DIAMETER OF HOLE: 4"	
	RISER PIPE I.D.: 2" TYPE OF RISER PIPE: SCH 4	
	TYPE OF BACKFILL: Bentonite	e (3/4" Chips)
108	ELEVATION/DEPTH TOP OF SEA	
	ELEVATION/DEPTH TOP OF BED	
	TYPE OF SEAL: Bentonale (3	(4" Chips)
'	ELEVATION/DEPTH TOP OF SAN	D: <u>98.0/12.5</u>
	ELEVATION/DEPTH TOP OF SCR TYPE OF SCREEN: Machine S	lotted
	SLOT SIZE x LENGTH: 10 SLOT	× 5
	I.D. SCREEN: 2"	1
	TYPE OF SAND PACK: SAND	(TYPE OS)
	DIAMETER OF HOLE IN BEDROC	K:3 7/8"
	CORE/REAM: CORE	
	ELEVATION/DEPTH BOTTOM SCR	
	ELEVATION/DEPTH BOTTOM OF	
	BACKFILL MATERIAL BELOW SAI Bentonite 3/4" o	ND:



PROJECT Quarry - RI LO		ILLER C. Palmer
	RING SB-QRY-OIB DR	ILLING Drive! HG THOD Wash Wireline
DATE BEGUN 08/22/12 DA	TE COMPLETED 08/23 12 ME	THOD Wash Wireline
FIELD GEOLOGIST B. Gering &	DE	VELOPMENT PHAP
GROUND ELEVATION 116.37 DA	ME 88 GVAN MUT.	THOD Whole - Surge
Ĭ.	ELEVATION/HEIGHT OF TOP OF SUR	FACE CASING: 113.17/ 2.8
8		
07/20/99	ELEVATION/HEIGHT TOP OF RISER:	113.03/2.66
20	ELEVATION/HEIGHT TOP OF RISER.	··// 4.66
5		
Š	TYPE OF SURFACE SEAL: CONC	Œ1E
ACAD: FORM_JAWKINBR. dwg		
	12 05 SUBSIOS 045740 4*	
	1.U. OF SURFACE CASING:	
	(5' long)	
² // // // // // // // // // // // // /	DIAMETER OF HOLE:	
	RISER PIPE I.D.: 2"	
	RISER PIPE I.D.: 2	to the
	THE OF RISER PIPE: 300	B 112
	TYPE OF BACKFILL: Bylonik (3	14" chips)
	ELEVATION/DEPTH TOP OF SEAL:	106.87/3.5
T.O.R.	ELEVATION/DEPTH TOP OF BEDROCK	(: 101.87 8.5
	TYPE OF SEAL: Bentonite (3/4"	
	TIPE OF SEAL: OCHIMATE (74	Ciup)
	ELEVATION / DEPTH TOP OF SAND:	94.37 / 16.0
		A PART OF THE PART
		9227 190
—	ELEVATION/DEPTH TOP OF SCREEN: TYPE OF SCREEN: Machine Sight	
	SLOT SIZE X LENGTH: 10 SCOT XI	0
	I.D. SCREEN: 24	
	TYPE OF SAND PACK: SAND (TY	pe Os)
— —		<u> </u>
	DIAMETER OF HOLE IN DEPARTMENT	2 7/2"
	DIAMETER OF HOLE IN BEDROCK: _	310
	CORE/REAM: CORE	
	ELEVATION/DEPTH BOTTOM SCREEN:	82.37/ 28.0
	ELEVATION/DEPTH BOTTOM OF SAN	
	ELEVATION/DEPTH BOTTOM OF HOLE	
	BACKFILL MATERIAL BELOW SAND:_	NIK

WELL NO .: MW-QRY-02-



	PROJECT NO. 1/2602063 E	LOCATION Former NASB BORING SB-GR4-02 DATE COMPLETED 08/20/12	DRILLER C. Palme DRILLING Drive ? METHOD Wash	HQ Wireline
	FIELD GEOLOGIST B. Geringer	88 OVAN MUTAC	DEVELOPMENT METHOD Whale	Pump & - Surge
ACAD: FORM_MWINBR.dwg 67/20/99 INL		ELEVATION/HEIGHT OF TOP OF ELEVATION/HEIGHT TOP OF RIS TYPE OF SURFACE SEAL: Cor I.D. OF SURFACE CASING:	SER: 105.	5.78/ 2.46 68/ 2.84
ACAD:		C 3/	4" 40 PVC	
		TYPE OF BACKFILL: Bentanil	(3/4" Chips)	
	T.O.R.	ELEVATION/DEPTH TOP OF SEA ELEVATION/DEPTH TOP OF BED TYPE OF SEAL: Bertrike	ROCK: 95	39 ₁ 3.5 39 ₂ 7.5
		ELEVATION/DEPTH TOP OF SAM	1D: 97.	82/10.0
		ELEVATION/DEPTH TOP OF SCR TYPE OF SCREEN: Machine S SLOT SIZE x LENGTH: 10 SLOT I.D. SCREEN: 2" TYPE OF SAND PACK: SANS	ik 10	82/12.0
		DIAMETER OF HOLE IN BEDROO CORE/REAM:	REEN: 80	.82/22.0 1 /22.0
		ELEVATION/DEPTH BOTTOM OF BACKFILL MATERIAL BELOW SA	HOLE:	1 / 22.0

PROJECT NAME: Quarry Remedial In	vestigation	PROJECT NO: 112G02063
PROJECT LOCATION: Former NASB		WELL NO: MW-QRY-03
CLIENT: NAVY		BORING NO: SB-QRY-03
Carl Carl Carl	C Palmer	BORING LOCATION:
CONTRACTOR: Fast Coast Explorations	DRILLER: U. VALUE	383185.55 Northey
OGGED BY: B.Geringer		3010138.79 Easting
HECKED BY:	DATE:	PAGE: 1 OF 1
ELEVATION TOP OF PROTECTIVE ASING 45.41	LENGTH OF PROTECTIVE C	CASING ABOVE
LEVATION TOP OF	GROUND SURFACE (Ft.)	<u> </u>
LEVATION TOP OF 95.31'	LENGTH OF RISER PIPE A SURFACE (Ft.)	ABOVE GROUND 2.5
ROUND 42.81		
	TYPE OF SURFACE SEAL	21.11
	DIA. SURFACE SEAL BGS	100
	DEPTH TO BOTTOM OF SURFA	ACE SEAL (Ft.)
SAND DRAIN LAYER	i.d. of protective cas	SING (III.)
	TYPE OF PROTECTIVE CAS	
	DEPTH BOTTOM OF PROTECTI	IVE CASING (Ft.) 2.4
	DEPTH BOTTOM OF DRAIN	LAYER (Ft.) 2.5
	RISER PIPE (In.) I.D .:	2.0 O.D.: 2.315
	TYPE OF RISER PIPE	SCH 40 PVC
		ND RISER PIPE Bentonite (3/4" chas)
	11.	75
	DEPTH TOP OF SEAL (Ft.	Bentonite (3/4" Chips)
	TYPE OF SEAL	
	DEPTH BOTTOM OF SEAL	
	DEPTH TOP OF PERVIOUS	SECTION (Ft.) 5.5
	DIAMETER OF BOREHOLE	(In.) 4
	TYPE OF PERVIOUS SECT	
	TYPE OF OPENINGS	10 300
	PERVIOUS SECTION (In. 1.D	.: 2.0 o.p.: 2.375
	TYPE OF FILTER PACK AN	ROUND SAND (Type 03)
	PERVIOUS SECTION	10=
	DEPTH BOTTOM OF PERVIOUS	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	DEPTH BOTTOM OF FILTER	R PACK (Ft.)
	TYPE OF BACKFILL BELOW FI	Bentonite (4 chips)
		31.0
	END OF BORING(Ft.)	

GENERAL NOTE:

^{1.} Entry of 0.00 for Ground Elevation, Elev. Top of Riser Pipe & Elev. Top of Protective Casing Indicates that Surveyed Ground Elevation Not Available.

WELL NO .: MW-QRY-04



	PROJECT QUARTY RT PROJECT NO. 112602063 DATE BEGUN 08/21/12 FIELD GEOLOGIST B. Gernger GROUND ELEVATION 94.40'	BORING SB-GRY-04 DATE COMPLETED 08(22)12	DRILLER C. Palmer DRILLING Drive; Work/ METHOD HA Wireline DEVELOPMENT Pump; METHOD Whale/ Surge
/99 INL	4	ELEVATION/HEIGHT OF TOP OF	SURFACE CASING: 97.35/ 2.95
62/29/88		ELEVATION/HEIGHT TOP OF RIS	SER: 97.25/2.85
WINBR. dwg		TYPE OF SURFACE SEAL: Cor	krete
ACAD: FORM_MWINBR.dwg		I.D. OF SURFACE CASING:	<u>1" </u>
ACA		DIAMETER OF HOLE:	*
		RISER PIPE I.D.: 2 TYPE OF RISER PIPE: \$2H	no Pac
		TYPE OF BACKFILL: Bentonite	2 (3/4" chips)
	T.O.R.	ELEVATION/DEPTH TOP OF BED	ROCK: 88,15/695
		TYPE OF SEAL: Bentonite (3/	1"Chips)
\(\bar{2}\)		ELEVATION/DEPTH TOP OF SAN	87.4 / 7.0
		ELEVATION DEPTH TOP OF SCR TYPE OF SCREEN: Machine S	lotted
		SLOT SIZE × LENGTH: 10 SLOT I.D. SCREEN: 2"	
		TYPE OF SAND PACK: SAND	
		DIAMETER OF HOLE IN BEDROO CORE/REAM: CORE	K: <u>5 15</u>
		ELEVATION/DEPTH BOTTOM SCE ELEVATION/DEPTH BOTTOM OF ELEVATION/DEPTH BOTTOM OF	SAND: 77.4 / 17.0
		BACKFILL MATERIAL BELOW SA	



	PROJECT NAS Brunswick LO PROJECT NO. 11290 2003 / 20045 BC DATE BEGUN 10/29/13 DA FIELD GEOLOGIST T. FILM NS GROUND ELEVATION 94265 DA	ORINGATE_COMPLETED	DRILLER East Coast DRILLING Exploration METHOD Drive & wash / DEVELOPMENT It Core METHOD Syb. Aumy
99 INL	4	ELEVATION/HEIGHT OF TOP OF	SURFACE CASING: 97.44 2.77
07/20/99		ELEVATION/HEIGHT TOP OF RIS	SER: 97.24, 2,59
IBR.dwg		TYPE OF SURFACE SEAL: Con	ncrete
ACAD: FORM_MWINBR.		I.D. OF SURFACE CASING:	4"
ACAD		DIAMETER OF HOLE:	4"
		RISER PIPE I.D.: TYPE OF RISER PIPE: Sched	2" Leyopul
		TYPE OF BACKFILL: Bent	inite
T T	TOR.	ELEVATION/DEPTH TOP OF SEA ELEVATION/DEPTH TOP OF BED	
		TYPE OF SEAL: Ben to 1	the state of the s
		ELEVATION/DEPTH TOP OF SAN	ID: 17.0
		ELEVATION/DEPTH TOP OF SCR TYPE OF SCREEN: Schedule SLOT SIZE x LENGTH: 0.0/0 I.D. SCREEN: 21	e 40 PVC
		TYPE OF SAND PACK: US S	20-30)
		DIAMETER OF HOLE IN BEDROCK CORE/REAM: Hole Core	к: <u>4"</u> - <u>е</u>
		ELEVATION/DEPTH BOTTOM SCR ELEVATION/DEPTH BOTTOM OF ELEVATION/DEPTH BOTTOM OF BACKFILL MATERIAL BELOW SAN	SAND: /19.5 HOLE: /19.5



	PROJECT NAS BWNSWIZL LO PROJECT NO. 1/2G02063/00645 BO DATE BEGUN 10/30/13 DA FIELD GEOLOGIST T. EVANS GROUND ELEVATION 106.61 DA	ORING MW-QNY-06 TE COMPLETED 10/31/13	DRILLER East Coast DRILLING Exploration METHOD Drive of Wash Bre DEVELOPMENT METHOD SUB Pump
B INL		ELEVATION/HEIGHT OF TOP OF	SURFACE CASING: 10951/ 2,90
62/26/88		ELEVATION/HEIGHT TOP OF RIS	SER: 109.29/ 2.68
NBR.dwg		TYPE OF SURFACE SEAL:(encrete
ACAD: FORM_MWINBR.dwg		I.D. OF SURFACE CASING:	4"
ACAD		DIAMETER OF HOLE:	4"
		RISER PIPE I.D.:	2" le 40 PUL
		TYPE OF BACKFILL: Ben	tonite
	J.O.R.	— ELEVATION/DEPTH TOP OF SEAL — ELEVATION/DEPTH TOP OF BEDI — TYPE OF SEAL: Bender	ROCK: 1 4.5
		TIPE OF SEAL!	
		ELEVATION/DEPTH TOP OF SAN	D:
		TYPE OF SAND PACK: OS	40 PUC in x 10 ft
		— DIAMETER OF HOLE IN BEDROCK CORE/REAM: 1+Q C	k: 4"
		ELEVATION/DEPTH BOTTOM SCR ELEVATION/DEPTH BOTTOM OF I ELEVATION/DEPTH BOTTOM OF I BACKFILL MATERIAL BELOW SAN	SAND: 126.5 HOLE: 126.5

WELL NO .: MW-QRY-07

TE TETRATECH

	PROJECT NAS BNNSWICK LO PROJECT NO. 1/2 GO 2063/00645 BO DATE BEGUN 11-4-13 DA	DEATION QUARTY DRING MW-QRY-07 ATE COMPLETED 11-4-13	DRILLER <u>East Gast Explora too</u> DRILLING <u>Drived</u> Was h / Core
	FIELD GEOLOGIST T. Evan		DEVELOPMENT SUB. PUMP
99 INL		ELEVATION/HEIGHT OF TOP OF	SURFACE CASING: 93,56/ 2,65
67/26/99		ELEVATION/HEIGHT TOP OF RIS	SER: 93.44/2.53
NBR.dwg		TYPE OF SURFACE SEAL:	ncrefe
ACAD: FORM_MWINBR.dwg		I.D. OF SURFACE CASING:	4"
ACAD:			<u>y"</u>
		RISER PIPE I.D.: TYPE OF RISER PIPE:	24
		TYPE OF BACKFILL: Bent	Dai PC
	TOP D	ELEVATION/DEPTH TOP OF SEA	The state of the s
		TYPE OF SEAL:	
		ELEVATION/DEPTH TOP OF SAN	D:
		TYPE OF SCREEN: Schedu SLOT SIZE x LENGTH: 0,010 I.D. SCREEN: 210	12 40 PVC
		TYPE OF SAND PACK: S	
		DIAMETER OF HOLE IN BEDROCK	« <u> </u>
		ELEVATION/DEPTH BOTTOM SCR ELEVATION/DEPTH BOTTOM OF S ELEVATION/DEPTH BOTTOM OF S BACKFILL MATERIAL BELOW SAN	SAND: /27.5 HOLE: /27.5

WELL NO .: MW-QM-08



	PROJECT NAS Brunswick LOUPROJECT NO. 112G-0263/00645 BO DATE BEGUN 11-5-13 DA FIELD GEOLOGIST T. Evans GROUND ELEVATION 99,71 DA	RING MW-DRY-08 TE COMPLETED 11-5-13	DRILLER East Coast Exploration DRILLING METHOD Drive & Wash / Core DEVELOPMENT SUb. Pump
INI			SURFACE CASING: 102,59/ 2,88
97/29/99		ELEVATION/HEIGHT TOP OF RIS	SER: 102.43/2.72
BR.dwg		TYPE OF SURFACE SEAL: Co	ncrete
ACAD: FORM_MWINBR.dwg		— I.D. OF SURFACE CASING:	1
ACAD: FC		— DIAMETER OF HOLE:	
		—RISER PIPE I.D.:	
		TYPE OF RISER PIPE: Schedo	le 40 pv c
Ť		— TYPE OF BACKFILL: BENT	onite
- 5 S.		— ELEVATION/DEPTH TOP OF SEA	. , 3.0
	I.O.R.	- ELEVATION/DEPTH TOP OF BEDI	ROCK: / 4.3
34		TYPE OF SEAL: 15000TOW	1 10
		ELEVATION/DEPTH TOP OF SAN	D:
		TYPE OF SCREEN: Schedule SLOT SIZE x LENGTH: 0,016 I.D. SCREEN:	40 PUC
		TYPE OF SAND PACK: ØS	Sand
		ORE/REAM:	« <u> </u>
		ELEVATION/DEPTH BOTTOM SCR ELEVATION/DEPTH BOTTOM OF I ELEVATION/DEPTH BOTTOM OF I BACKFILL MATERIAL BELOW SAN	SAND: / 18.9 HOLE: / 20.0 ID:

WELL NO .: MW-GRY-OG



OVERBURDEN MONITORING WELL SHEET STICK-UP

PROJECT MAS Brumswiz	L LOCATION OSLVY	DRILLER East Coast Exploration
PROJECT NO. 112602063/0	DATE COMPLETED 11-6-13	METHOD Drives wash
FIELD GEOLOGIST TIE GROUND ELEVATION 94.	vans	DEVELOPMENT METHOD Sub Pump
GROUND ELEVATION 94.	15 DATUM NAVO 88	METHOD SUB . POWA
Z	ELEVATION/HEIGHT OF TOP OF	SURFACE CASING: 96.53/ 2.38
97/28/99	ELEVATION/HEIGHT OF TOP OF	RISER PIPE: 96.34/ 2,19
Wash day	TYPE OF SURFACE SEAL:	Concrete
ACAD: FORM JAW	I.D. OF SURFACE CASING: TYPE OF SURFACE CASING:	4" stee 1
	RISER PIPE I.D.: 2" TYPE OF RISER PIPE: Sched	sle 40 pvc
	BOREHOLE DIAMETER: 4	u
	TYPE OF BACKFILL: Bent	nik
	ELEVATION/DEPTH TOP OF SEA	
	TYPE OF SEAL: Benton	
	DEPTH TOP OF SAND PACK:	
	TYPE OF SCREEN: Schedu	
	SLOT SIZE x LENGTH: 0,010	
	I.D. OF SCREEN: 2"	<u> </u>
	TYPE OF SAND PACK: Hollist	n Øs Sand
	ELEVATION/DEPTH BOTTOM OF	SCREEN: / /3.0
	ELEVATION/DEPTH BOTTOM OF BACKFILL MATERIAL BELOW SA	SAND PACK:
	ELEVATION/DEPTH OF HOLE:	

WELL NO .: MW-QRY-10



OVERBURDEN MONITORING WELL SHEET STICK-UP

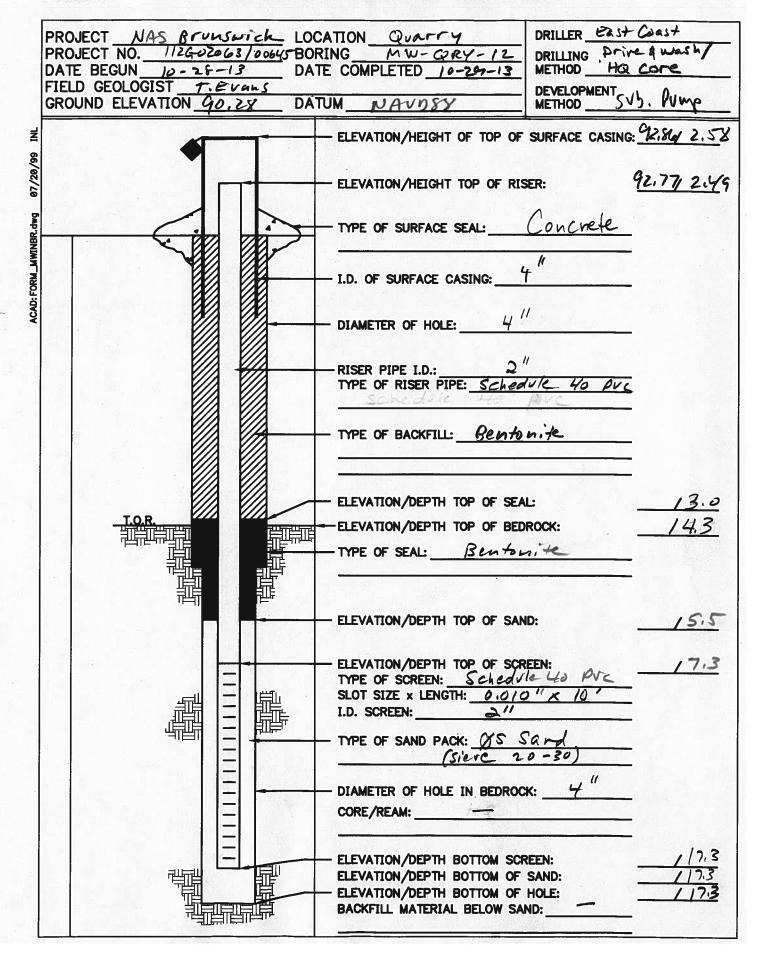
	PROJECT NO. 12 GO ZO 63 / 006 45 B DATE BEGUN 1 -1-13 D FIELD GEOLOGIST T. EU a	DATE COMPLETED 11-1-13 METHOD Drive & Was G
ACAD: FORM_MWSU.dwg 67/26/99 INL	GROUND ELEVATION \$1133 D	ELEVATION/HEIGHT OF TOP OF SURFACE CASING: 91.74/ 2.4 — ELEVATION/HEIGHT OF TOP OF RISER PIPE: 91.60/ 2.2 — TYPE OF SURFACE SEAL: Courte — I.D. OF SURFACE CASING: 4" TYPE OF SURFACE CASING: 5+ee — RISER PIPE I.D.: 2" TYPE OF RISER PIPE: Schedule 40 PVC
		BOREHOLE DIAMETER: 40 PVC TYPE OF BACKFILL: Benton, te ELEVATION/DEPTH TOP OF SEAL: 13.0 TYPE OF SEAL: Benton, te
		DEPTH TOP OF SAND PACK:
		TYPE OF SAND PACK: Hollistan & S ELEVATION/DEPTH BOTTOM OF SCREEN: ELEVATION/DEPTH BOTTOM OF SAND PACK: BACKFILL MATERIAL BELOW SAND: 14.0
2		ELEVATION/DEPTH OF HOLE: 14,8



OVERBURDEN MONITORING WELL SHEET STICK-UP

PROJECT WAS BOUND TO LEVAL PROJECT NO. 1126-020-03 /00644 DATE BEGUN 10 /21 / 13 FIELD GEOLOGIST T. EVE GROUND ELEVATION 91.55	DATE COMPLETED 11/1/13 DEVELOPMENT	emtin
	ELEVATION/HEIGHT OF TOP OF SURFACE CASING: ELEVATION/HEIGHT OF TOP OF RISER PIPE:	
	TYPE OF SURFACE SEAL: Concrete	
	I.D. OF SURFACE CASING: 4" TYPE OF SURFACE CASING: 5+0-1	
	RISER PIPE I.D.: 2" TYPE OF RISER PIPE: Schedule 40 PVC	
	BOREHOLE DIAMETER:	
	TYPE OF BACKFILL: Bentonite	
	ELEVATION/DEPTH TOP OF SEAL: TYPE OF SEAL: Rentonite	/ 3.0
	DEPTH TOP OF SAND PACK:	14.5
	TYPE OF SCREEN: Schedule 40 PC	15.5
	SLOT SIZE x LENGTH: 0.010 "× 10"	
	I.D. OF SCREEN:	
	TYPE OF SAND PACK: OS sand (Sieve 20-30)	
	ELEVATION/DEPTH BOTTOM OF SCREEN:	110.5
	ELEVATION/DEPTH BOTTOM OF SAND PACK: BACKFILL MATERIAL BELOW SAND: Natural	110:5
	ELEVATION/DEPTH OF HOLE:	111.5





A-3 WELL DEVELOPMENT LOGS

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-
150
F

WELL DEVELOPMENT DATA SHEET

Well	No.:	mw. Grey - ON
		IIIW WELL DIS

			11-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		25%			255	
PROJECT: _	Former NASB- Site 12 R	ു Remedial Inves	stigation	200.		DATE: 8/a	ilia		
	O.: 112G00645/112G0		17.			WEATHER: 8			
SAMPLE ID:	N/A					PERSONNEL:			
		TO 20.7							
Well Screen I	Depth:(3/_	18 ft.	bas Pump	Type/Material:	Whale	/ Poly	Total P	urge Volume = _	NA (gal)
	ng Instrument Reading _		Pump	Intake Depth:	Bottom		Data R	ecorded By:	31
Time	Water Level ft below top PVC	Volume mL	Flow Rate mL/min	Temp °C	рН	Sp Cond mS/cm	DO mg/L	Turbidity NTU	Comments
1400	DRY	- Add	5008	ofwa	0.1				
	0	wate	n Beel	drappe	d-no	reinel no	vexe		
		in the second							
								-	
			1) S/A/2						17-11-10-3
						T WALL		District Control	
			20,000						
					1				1000

1		
	Б.	
-	ж.	
		-
		-

WELL DEVELOPMENT DATA SHEET

Well No .: MW-QKY-OB

PROJECT NO	D.: 112G00645/112G0)2063				DATE: <u>8/2</u> WEATHER: 3 :			
SAMPLE ID:	N/A					PERSONNEL:			
Vinitial	24.90 TD: 2	730.06	8/0:2.7	7 TPVC:	0.15' to TO	χ.			
Well Screen [Depth: <u>(8</u> /_	28 ft.	bgs Pump	Гуре/Material:	whale	oump	Total Pu	ırge Volume =	40 (gal)
	ng Instrument Reading				variable	throughouts	Data Re	corded BA	
Time	Water Level ft below top PVC	Volume Int gal	Flow Rate	Temp °C	рН	Sp Cond	Mart Okh	Turbidity NTU	Comments
6920			satorate	screen	WOUF	purgina			
0925			& purae	- V. 5114	y brow	W 2 2			
8933	25'	٥	tagel four	10.50	16.96	213	428	3559	bottom
0942		8	1/gallann		7.08	185	35.1	2499	na ox bottom
0996			•	10.52	682	17-7	34.7	840	-4196 Popu
0958		12	20-5/mm	10.26	677	164	5(.7	57.0	1200
0957		15		10.10	6.90	155	54.0	47.1	no Hon
1001				10.13	6.93	151	50.3	28.4	eying bolton
1011		22		10.08	6.94	141	58.8	9.26	60 tran
1015		25	1015	10.11	6.95	138	60.7	27.9	1 You hottage
1019		27		10.09	697	136	64.6	7.55	~ 4 of botter
1030		2540		9,96	F3701	130	68.9	9.35	bottom
+		End a	puelopmen		EIEP X		1. 12. 14. 15. 14.11	S 1	
						The Falls of			
	1 (A) (A) (A) (A)			A SWI		- 1/4 E/A	11823		

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WELL DEVELOPMENT DATA SHEET

Well No.: MW-QRY-02

Vell S	Screen Do	7.52 †0: <i>24.</i> epth: 12 /	22 ft.	bgs Pump	Type/Material:	whale,	PERSONNEL: J	Total Pu	irge Volume =	7 (gal)
1&S N	Monitoring T	g Instrument Reading	104	Pump	Intake Depth: \(\)	ionable	throughout so comment	Data Re	corded By:	rais
Ti	me	Water Level ft below top PVC	Volume mtgcel	Flow Rate mL/min qol	Temp °C	рН	Sp Cond #S/cm	mg/L	Turbidity NTU	Comment
- 1	010	Surac	1 W W	NAINA	through	nut schee	^		(2)	
_	933	Byen a Final	Begin Su	raina a k		- ran c		al V. Si	ty-nore	dinas
	25.54		No.	charge'	Nomi	1083	actioner tar	na much lor	ger	
16	115	No wenter a	1920 11482	~ 2 gal/min	10.23	7.29	2320	775.4	61.5	
	45	19.05	25		10.01	7.19	202	99.9	21.0	1. 1. Sept. 17
	45	18.9	+3.		10.62	7.13	185	98.2	15.9	
	50	17.7	3,5		9.9 +	7.17	155	113.6	11.9	
	25	18.2	MY		10.36	7.21	155	153.6	15.8	
	35	8.38	,5		10.57	7.02	147	130. 2	9.30	
	115	18.32	4	1 2 2	10.70	7.45	13)	90.8	9.35	
0	962	17.83			10.08	7.14	126.121	126.7	5.98	No. of the last
			End	devels	pmend					
200		- h-								8 21 1
144										-
-	7 72		San San San				187 js.			
			AND THE RESERVED				(198)	no three-contract		

TtNUS Form 0013

Page ____ of ___

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WELL DEVELOPMENT DATA SHEET

Well No .: MW-QRY-Q3

PROJECT NO	.: 112G00645/112G0	2063	stigation			DATE: <u>8/22</u> WEATHER: <u>1</u>		1551	
SAMPLE ID:			14 2 3 ET			PERSONNEL:	Tal Caus	+	
		(2.0	2000 2016	+0:10.		PERSONNEL	Jo1100		
Y I MI Day:	9.1'TPVC TO:	14.71	510: 251	rve:	0.1 to 122				
Well Screen D	epth: <u>5.5</u> /_	10.5 ft	bas Pump T	ype/Material:	whoop	DAY P	Total P	urge Volume =	28 (041)
	g Instrument Reading	Λ				rsurging		ecorded By:	. /
	g msudment reading _	D 19	Fullip II	make Depuil. S	ng trom k	ntton	— Data N	ecorded by.	
	**************************************		Mark III	70)	3 110111	- 1001	OLD	$\overline{}$	
Time	Water Level	Volume	Flow Rate	Temp	pН	Sp Cond	100	Turbidity	Comments
	ft below top PVC	mL	mŁ/min	°C		/m S/cm	mg/L	NTU	
1100		gal	gal	1.0		м	mv		
1405		surge 1	plant porg	rd thus	ghout g	associedsa			
1415 14181420	910	35	vagalland	J14.44 H.16	34.07		34.0	alerrange	VSINY Ra
	9.15			14,17	7.18 698	217	-10.3 14.0	1723	Cecovers a-1
1475	9.0 *	8		(3.67	6.89	199	225	- 71	3 yield ber
1507	9.1	12		1397	6.78	219	6,4	1(2)	o greater
1512	*	14		13.55	4.55	195	180	31.1	Stop aumined
1515	9.25	17		13.47	6.52	191	17.2	66.5	Stop aunivied
1520	9.25	19		13.81	6.47	189	19.6	16.0	SIND Douge
1525	TOTAL TOTAL	22		13.98	6.37	189	18.2	137	
1527		25		13.44	6.30	182	27.1	9.46	allowrecho
1530		68		13.81	6.38	185	20.8	9-26	
		FAC C	level opm	ent					
				J.7' E					N 1
1784 2 30									
			The Subsection of the	Page 1					
	The second of th	THE RESERVE OF	CT-CT-CT-CT-CT-CT-CT-CT-CT-CT-CT-CT-CT-C						

TtNUS Form 0013

* we recharge = intake, we at bottom - will recharge to 9.25 ~/min Page I of

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WELL DEVELOPMENT DATA SHEET

Well No .: MW-OKY-04

						7777			territi.
PROJECT: _F	Former NASB-Quarry	Remedial Inve	stigation			DATE: 81231	12		
PROJECT NO	: 112G00645/112G	02063			ev ===-1	WEATHER: 80	Sim c	1001	
SAMPLE ID:	N/A				6.1	PERSONNEL:	Trait		
	2: 8.9 TPVC	TD:18	.91						
Well Screen D	Depth: 8 /	\(a ft	bas Pump 1	Type/Material:	whale	IN OM AP	Total Pu	ırge Volume =	70 (gal)
	ig Instrument Reading	THE PERSON NAMED IN COLUMN		ntake Depth:	Vanable	throughoutson	neh Data Re	ecorded By:	hos
Time	Water Level ft below top PVC	Volume mlz go_Q	Flow Rate	Temp °C	рН	Sp Cond -mS/cm	OLD BO mg/L WW	Turbidity NTU	Comments
1325		1 7 8	wae wild	regula for	ma throa	John t Sch	201-		
1330		Beg	n purgina	A SURA	8				
1335		170	Zgattner	6(8)	7.99	305	37.6	87.3	bottom sug
(340	10.7	15	0 .	14.48	7.13	277	15.3	55.8	25 of bottom
1343	10.7	18	Bit Bitza Miss	14-17	6.98	266	286	39	25'01 WHEN
1347		22		14.20	7.02	262	20.0	254	motton
1361		32		13.83	6.72	254	36,3	35.8 28.3	500 bottom
1353		36		13.61	6.73	254	36.0	28.3	12.5°04 6010M
1355			an usi a	13.43	6.83	256	28.2	રૂપ. જ	pottom
			na to como	HIDW				THE ROOM OF	
1415		leneme	purejug "	1			20.	10.0	
1400	10.7			13.84	7.15	256	37.5	25.2	bottom
1425				14.16	7.85	253	35.1	27.9	5'00 00 DW
1427		47		13.84		252	352	17.5	
M31				13.82	677	252	36.7	14.5	25 0100m
1434	Westing (2)			13.6 4	6.69	346	37.4	13.6	
1437		40		15.58	6 66	246	28 4		DO STOWN
1437		VO		13.58	6.66	246	38.6	14.5	bottom

TtNUS Form 0013

Page / of 2

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SAMPLE ID: N/A

TETRA TECH NUS, INC.

PROJECT: Former NASB-Quarry Remedial Investigation

PROJECT NO.: 112G00645/112G02063

WELL DEVELOPMENT DATA SHEET

DATE: 8/23/12	
WEATHER: 80' SUN	
PERSONNEL: T. Nowo	

Well No .: MW-QKY-04

Well Screen Depth: 68 / 1816 ft. bgs Pump Type/Material: Whale

Pump Intake Depth: 4 valbe

See Comments

Total Purge Volume = 70 (gal)

Data Recorded By: 10 miles

		a		1923	ععد	Columbia	200 - 12/10/2005		
Time	Water Level ft below top PVC	Volume mt.	Flow Rate mt/min	Temp °C	рН	Sp Cond mS/cm	ORD DO Mg/L MV	Turbidity NTU	Comments
1443	1017	0	2gal/min	13.58	6.77	241	41.0	15.3	250g both
1445	10.2	70	0	13.42	6.63	240	45.5	165	60
	1		eleppmen		am otel	1 State			
		111111111111111111111111111111111111111	Topicos.	7000		a selusia			
- 100 EII I	TO THE STREET					i, Ekrim			
					- X-134 - 1	The state of the s			
			*	Total Control					
				and the second					
								E-11-11-11-11-11-11-11-11-11-11-11-11-11	
		ge Domest				20 10 10 10	5 Van 18 18 18 18 18 18 18 18 18 18 18 18 18		
		ment and			Section 1	, market		La XII a	Engles and
		-		-				 	
								The fact of the South	
According to					1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				
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							S 11/2/2020		
								24 37	

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ite Installe	ed:	12013	Static Water Le	evel After (ft.): m (ft.):	9,42	2131	Drilling Co.: Project Name: Project Numb	NAS BI	12063 /
w. Method mp Type	d: Silo. : whale	Pump	Screen Length Casing ID (in.):	(ft.):2_	25			city:	=
Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)
8,401	\display	ф	9.40	6,37	12,20	1408	>800	110	very turbled
:46	Ò	4	9.46	6.87	11.910	1365	>800	89	Very tucked
153	0	12	9.43	6,97	11.74	1366	7800	-50?	Turblel
2.02	ä	24 18	9.86	4,99	11.52	356	206	-24 ?	slightly clearer, but a
113	0	24	9.00	6187	11.50	1357	70.8	-107	clearer
117	0		9.59	6.82	11.53	, 35%	49.9	~/7?	Cleaner
3:46	0	34	9.95	6,78	11,27	.357	36,3	-18?	cleared
1257	+	40	9,90	6.72	11.44	1357	25.5	-4!	clearer
9:57	0	76	999	6.63	11.58	1350	24,3	2	Cleares
0.06	9	52	9.99	6.61	11.54	351	16,3	11	cleares
0:10	\delta	56	9.90	6.60	11.67	1350	10,4	9	Glearer
10:34	9	62	9.96	6.78	11.69	1352	10.1	7	Cleares
10:39	9	68	9.95	6.76	11,73	,354	7,3	-4?	Cleaser

		,		4					

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	Th	TETRA TECH	

Page of ___

e Devel		15/2013	Depth to Botton	n (ft.):	29,68		Project Number	er: <u>//26-0</u>	7063
. Methon			Screen Length Casing ID (in.):			- CN	Specific Capac	city:	
Γime	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units 45/(4)	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)
1500	0	0	20,70	6,17	9.57	1202	>800	1450	Start/Blown/tul
250	0	2	21,20	6.59	9.18	1124	>850	684	dist / Such
36	ي	5gd	20.9	6,22	8.83	115	2800	623	Clandy
45	0	6.050	21,0	602	8,59	1109	677	505	cloudy, clearer.
53	Ð	10901	24 33,7	5.81	8:50	114	2800	84/214	Clandy, clearer
Sa	9	Magal	21,20	5.88	8.75	,105	10.15	2/6	Clarify / Clear
19	0	15-001	21,95	5.90	8.42	,100	>800	223	Clerch
143	0	15/199	21.96	5.73	8,26	1100	558	5585827	Clandy, Clear
100	0	18.59.1	21.94	5,61	8.61	1102	280	229	cleatet
2111	0	22001	7/100	5.54	9.09	1102	193	19303	clearer
126	0	25,95	21.95	5.62	8.95	1096	99,6	729	Clearer
32	8	26.0	21,00	5.89	8,98	1100	170	7.2.2	Stoppy cloudy
143	9	275	21.95	5,71	9,07	1109	310	223	(Budles
153	a	28,0	2/190	5178	9,0	1103	420	222	Claudier

1	preconsts	TETDA	TECH
	It	TETRA	IECH

	oped:	6/2013	Static Water Lo	evel After (ft.):	36.80	2983	Drilling Co.:			
Pump Type	od: Sub : Whal	Pump	Screen Length Casing ID (in.):				Specific Capa	acity:		
Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	pН	Temp (degrees C)	Specific Cond. (Units# <u>\(\(\(\(\(\)\)\)</u>)	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)	
12:56	9	0	6,39	7.71	12,40	1242	>800	86	very turble	
1:19	7	3	490	8,41	H/21/01	1211	>800	88	Vory furbled	
2:25	. 0	6	15,70	8,21	10.65	. 202	7800	3	Very turbed	
1:40	ð	8 18	14.30	7.96	10.51	1198	450	-36	1855 turbid Co	
1.49	8	10	7,00	7.89	10,25	1196	555	-20	turbis	
1,59	7	13m1	1.40	7.82	10.16	1197	289	-37	Claudy	
2:21	3	14	4.600	7.76	10.10	1196	395	-55	elandy	
8 to 4	0	16	6.00	7.71	998	1195	457	-37	Kess Cloudy	
2.47	d	18	12.40	7.69	9.86	1194	360	-64	125 County	
2:57	ð	20	7.85	7.65	9.89	195	251	-40	185 cloudy	
3,09	0	22	8,00	7.64	9.79	194	210	-63	less cloudy	
3/4	ð	24	14.6	7.61	9.84	1195	326	-46	more claudy	
3:12	θ	30	20,15	7.61	9,77	1194	489	-66	GOOR Cloudy	
3:27	9	38	21,600	7.58	9,70	, AZ	189	-66	1035 cputy	
3:32	9	80	20,75	7,52	9.65	1195	776	-8/	clousiel '	
3:43	3	45	18.55	7.69	9.46	1/95	464	-65	Cloudy	
3.68	(c)	50	18,05	7.52	9.66	1194	570	-66	Cloudy	

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ate Instal ate Deve	MW-QA Warry led:	rons	Static Water Le Depth to Bottor Static Water Le Depth to Bottor Screen Length	evel Before (ft.): m Before (ft.): evel After (ft.): m (ft.):	29.83	za,83 za,30)™ i.41	Responsible F Drilling Co.: _ Project Name Project Numb	Personnel: :	Brunswick
ev. Meth ump Typ	e: <u> </u>		Screen Length Casing ID (in.):	(ft.):				icity:	
Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН 7. 53	Temp (degrees C)	Specific Cond. (Units 45 km)	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)
3.53	9	54.5	20,55	2105 m	9.63	1193	204	-7/	der
3:55	Q	55.5	20,80	7.50	9.61	1193	370	-90	Clear,
359	9	6015	20,82	7.48	9.61	.195	323	-07	clouby
	Ţ						10		
	7.44								
						-			
-								 	
	 								
	-	-			1				3
			1.00				0,000		
		†							
					11/12/15/24/1-15/24		JEE .		
dditional	Comments:	=					- B		
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The	TETRA	TECH

ev. Metho	ed:	punp	Depth to Botton Static Water Le Depth to Botton Screen Length Casing ID (in.):	evel After (ft.): m (ft.): (ft.):	16.45	2.3	Drilling Co.: Project Name: Project Number: Project Number: Specific Capacity:			
Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)	
1122	Ø	Ø	28.8	5.77	1(99	0.214	7800	8778	Start / Turbid, 91	
1205	2	3	13.06	6.28	11:81	0,710	COSK	100		
2:24		4	15.05	6.39	11.82	1196	>800	110	tuckid lacav	
2135		5	13.70	6.50	11.88	1188	2800	75	Cloudy 19/04	
2143		515	17.80	5.42	(1.63	1/3	180	40	(log Logs)	
1353	properties of an	U	13.75	5.86	11.67	MSM.	7000	1(0)	Close	
1319		6.5	14.80	5,18	11/08	1104	239	179	clear.	
338	a Backet	7.5	12,70	4.9	11.63.	1105	152	190	cloudy	
1351		9	14,00	485	11.62	1098	52.9	200	dear	
405		10	13,56	4.81	11.66	1096	31.3	199	clear	
473		10.5	1355	8.66	11.67	1095	70.4	337	clear	
1437		n	14.01	4.73	11.65	1093	73.7	223	clear	
01	Sheet all				V governor			Contract Con		
	ETE BAS									
	3.00									
	440									
						HIG				

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Danie S	t	TETRA	TECH

Well: MW-JR -09	_ Static Water Level Before (ft.): 9,82	F	Responsible Personnel: J.MaHS, T. Evans
Site: Quack	Depth to Bottom Before (ft.): /5.73		Drilling Co.:
Date Installed:	Static Water Level After (ft.):		Project Name: NAS Bruyswick
Date Developed: /// 7/ 2013	_ Depth to Bottom (ft.):	F	Project Number: //2 C-o20/o3 /
Dev. Method: Scho. Dans P	_ Screen Length (ft.):		
Pump Type: 4/hale.	_ Casing ID (in.):		Specific Capacity:

Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)
8:33	9	6	11,09	5.94	12.64	1132	>800	108	very trible Start
8139	J	9	9,86 =	786567	12,26	1096	2800	11	very turbid
8:43	P	14	11.62	H16 25.41	12/8	1082	>800	119	Very turble
8:50	9	18	11.04	551	12,08	1080	280	116	Very tustice
8154	Φ,	26	11.51	514	11,94	,076	676	127	trichle
9:04	0	22 24	9.86	8,98	11,99	1073	159	139	Clast
9:10	9	29	1655	4.95	11.99	1071	147	143	Clear
9:30	D	34	9,86e	502	11,99	1073	25	143	cloudy
9:23	9	36	11,52	489	11.94	1069	8Z.Z	106	clear
9127	6	4643	11.55	4.85 "	11.94	1049	82,2	171	Clear
9:30	3	46	11.54	4.82	11.90	1047	541	1.78	Clear
9144	2	47	11.32	4171	11.93	1066	28.0	185	Clear
9:49	9	53	11152	4.77	11.91	1048	33.7	174	st. doudy
9156	9	50-60	11,40	4.93	11.96	1064	131	161	alear.
10:01	8	64	12,55	4.80	11.97	set	32,3	185	cleat
10:08	D	12 Co	1195	8,85	11,99	0,0	134	88	clear
10125	Ò	70	11.48	4.90	12,00	1003	33.4	188	Clear

Additional Comments: [1 4011 Vdune = 1969al]

The	TETRA TECH
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Well: Site: Date Instal Date Deve	MM-DR Marry Nacry	7/2013 Pump	Static Water L. Depth to Botto Static Water L. Depth to Botto Screen Length Casing ID (in.):	m Before (ft.): evel After (ft.):	15.7		_ Project Numi _	oer. <u>// 25</u>	
Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units	_ Specific Capa Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)
10128	ď	75	11,94	4.79	11.86	, alt	320	198	Clear Clear
10136	2	82	11.65	4,78	11.98	,000	6500	197	clear
10:45		95	//,40	4,79	//. 8le	1065	9.8	217	Clear
	100					-			
Additional	Comments:								

	THE	TETRA TECH
1	4 69	

Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units <u>/uS/co</u>)	Turbidity (NTU)	ORP (mV)		emarks color, etc.)
3:09	10	1	14,00	6.05	12,84	, 265	7800	99	dirtilm	uddg
11:00	Ø	2	12.81*		11 15	10 -				water
1450	Ø	2.5	12.72*	5.67	11.15	01127	7800	103	Closdy	tan
1502	\$	3.0	14,00	5.95	12.05	0,126	>800	103	Cloudy	, tan
1515		3.25	14,10	6,20	11,27	0.123	>800	112	Torkid	tanbrown
1530		3.5	14.20	6.28	11.23	0,123	SOS	121	- 1 - v - 1	
1540		4,0	14.20	6.15	10.88	0.((8	7800	123		
557	1	5.0	14.20	6.17	10:30	0.114	> 800	134	V	
60	V	515	14.35	6.18	10.66	0,115	760	144	Cloudy	, tantint
600									End	
			fi fiyita							
		Tures To be								A.C.
									4 4	

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TE	TETRA	TECH

	MW-G		_Static Water Le			(TPUC)			T. Evans
	Quari		Depth to Botton				Drilling Co.:	East C	east Exploration
	led: 11-		_Static Water Le	Control of the Contro					Bruswick
	loped:		Depth to Botton		12.98		Project Numbe	r: 1/2 (202063 / 00645
	od: <u>รูป</u> อ: พ.ค.		Screen Length Casing ID (in.):		2		Specific Capac	itse	
rump Type	s. <u>10 ve</u>		_ Casing ID (in.).				Opecine Capac	ity.	
	Est.	Cumulative	Water Level			Consider			
Time	Sediment	Water	Readings	рН	Temp	Specific	Turbidity	ORP	Remarks
Tillle	Thickness	Volume	(ft. below	рп	(degrees C)	Cond. (Units ^{VMS} CM)	(NTU)	(mV)	(odor, color, etc.)
	(ft.)	(gal.)	TOC)			(Oracs			
1025	Ø	0,0	9.93	6.01	12.20	0.124	> 800	NW	START Turbid Brin
1035		25	9.98*	6.40	11.80	0.107	> 800		Cloudy
1045	ing sparing	4.0	9.96 **	6.44	11.86	0,113	701		Cloudy
1050		6.0	9.98 **	6.41	11.73	0.106	239		Clear
1053		7.5	12.63	6.37	11.52	0.121	11/		
1057		9.0	9.96 **	1.32	11.56	0.105	232		
1100		(2.0	12,30	6.15	11.47	0,097	239		
1110		12.0	9.95	6.28	11.74	0.109	127		
1120		14.0	9.96 *x	6.11	11.93	0.091	85		
1124		18.0	BTOP	5.92	11,73	0.090	25		
1129		20,0	998 XX	5.82	11.64	0,101	45		
1135		22.0	9.98**	5.83	11.73	0.082	15		
1142		24.0	9.98	b.07	11,73	0.080	34		
1148		26.0	BTOP	6.04	11.54	0.102	25		
1152		28.0	10.02	6.04	11.52	0,088	10		
1155	A	30.0	BTOP	6.04	11.54	0.090	10	V	V
							Self A		
Additional (Comments:	* Rev	reatedly	purce	& pun	n dry			
		* x he	asured'		mining	of Bur	Je Cyc	(e	斯·斯斯·斯·斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯斯
		BIOP	= hela	w top	of pu	de	NM'=	not u	easured,
									Page of

T.	TETRA TECH
----	------------

Site: Date Install Date Devel Dev. Metho		12013 nrp	Depth to Bottor Static Water Le Depth to Bottor Screen Length	epth to Bottom Before (ft.): tatic Water Level After (ft.): epth to Bottom (ft.): Project Name Project Numcreen Length (ft.): asing ID (in.): Specific Cap				er: //Z GO ZO LOS			
Time	Est. Sediment Thickness (ft.)	Cumulative Water Volume (gal.)	Water Level Readings (ft. below TOC)	рН	Temp (degrees C)	Specific Cond. (Units/145/14)	Turbidity (NTU)	ORP (mV)	Remarks (odor, color, etc.)		
12:580	~ Q	3	8.9.8	6.65	11,910	13/21	368	216	Start/ Slight cloudy		
1:00	9	4,5	5,56	10.88	11.94	13/09	295	126	Slighty Clearer.		
1:1400	م بی	mx 10	552	4.98	11.75	136/2	573	121	Claudier		
1;23.	9	10	5,52	6.89	11.57	1369	50,1	127	Clarrer SH. claus		
113 100	9	11	5,50	7.00	11.64	1370	30,le	128	Clearer		
1,400	0	1/0	5.53	6.97	11.510	1364	25.0	130	Clearer		
1,480	3	17	5.52	7.10	11,48	1367	17.8	130	cleaser		
159 pm	D	21	552	7.16	11,40	1365	163	132	Cleaser		
Zilpm	9	25	53496	7,04	11,25	1368	16.9	132	Clearer		
1:21	0	28,5	5,52	6.84	11.00	13 lela	34.5	134	Clearer 15/4.C/2		
2/35pm	0	30	5,53	6.88	11,17	1370	19,5	123	clearer		
2'44m	0	35	5.51	6.87	11,20	,365	18131519	119	charer		
2150	4	38	5152	4.80	11,49	1365 4	MHZ10.5	119	Clearel		
3:01	Э	41	5.52	6.87	11,21	1362	10,2	124	Clearer		
								10/27023	+		

Additional Comments: x 2) e// Volume of / = 2.45gal.

A-4 LOW-FL	OW PURGE DATA SH	IEETS AND GROUND	WATER SAMPLE LOGS	



Tetra Tech, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page_1 of _/

Project Site Name:	Former NAS	Former NASB - Quarry Area RI				le ID No.:	QRYD9-G	2R4D9-GWOIA-1213		
Site Location:	Maine	100				MW-GRY-DA B. Geringer				
Project No.:	2G00645				led By:					
[] Domestic Well Data [X] Monitoring Well Data	CTO NEO9	1126020	43		C.O.C					
[] Other Well Type:					of Sample: ₋ow / Moder	ate Conce	stration			
[] QA Sample Type:		11.5 (E.)			ration	muauon				
SAMPLING DATA:										
Date: 12/05/13	Color	Temp	80	DO	L au 1	ORP	Trank talle			
Time: 13a5	(Visual)	(°C)	S.C.	(mg/L)	pH (S.U.)	(mv)	Turbidity (NTU)	Other		
Method: Low stress (low-flow)	Clear	9.86	0.170	8.72	6.63	186.9	3.18			
PURGE DATA:		11.00	1 01170	10,10	ا جهانها	180.4	13:10	Transfer and		
Date: 12/05/13	Volume	Temp	S.C.	DO	pН	ORP	Turbidity	Other		
Method: Low stress (low-flow)			William Act		To 1000					
Pump Type: Bladder or Peristaltic		10.0								
Sample Tubing / Intake Depth: 2/6 655	A TOWN									
Nonitor Reading (ppm): 0.0					1110					
							100			
Vell Casing Diameter/Material: in 4in, or 6-in (ID) (PVC or steel										
Screen Interval (ft bgs): 13-18		W Year				15 7" " "T R				
Static Water Level (WL): /6.17										
otal Well Depth (TD): 2072	PH AIRE				THE PART					
VL & TD Measuring pt.: TPVC	The second	CITICAL	w. The							
Sat. Screen Volume(gal): 0,7335		1								
Start Purge (hrs): 1235					- 11					
and Purge (hrs): 1320										
otal Purge Time (min): 45										
otal Vol. Purged (gal): 23,5										
AMPLE COLLECTION INFORMATION:	i de Niverse									
Analysis		Preser	vative	Containe		r Requirements		Collected		
OCs Control of the Co		6°C / HCL		3 - 40 ml vials				Yes No		
DB	6°C / HCL		2 - 40 ml vials				(Yes) No			
PH	6°C / HCL		2 - 40 ml vials				Yes/ No			
PH			2 - 1 liter amber botles				Yes / No			
VOCs	-		2 - 1 liter amber botle			Yes/No				
CBs/Pesticides	in professional	Control of the Second		2 - 1 liter amber botles			(Yes/No			
xplosives (Including Nitroglycerine)			2 - 1 liter amber botles				Yes No			
erchlorate Metals					1 - 125 mTHDPE bottle (1-250)					
DBSERVATIONS / NOTES:	6°C / HNO ₃ 1 - 500-ml		HDPE bottle (1-250)			(Yes)/No				
The second secon										
Veather: Clark, Feu Shoulds, 305 'isual evidence of sheen on purge water - Y	es or No It ve	e describ	٥.							
Offactory evidence of odor - Yes o(N) If y		s, describ	·							
ir Supply: Compressed Gas (Nitrogen) or Co										
comments:										
ircle if Applicable:		mewille, a			Signature	(s):				
MS/MSD Duplicate	ID No.:	JATES DR			_	7 - 21				
					1	u/d				
						Q				

TE TETRA TECH, INC.						PURGE DATA SHEET - "LOW STRESS" GROUNDWATER										
Site Nam Sample II	e: <u>Former NA</u> D: <u>ଓ</u> ିଟେଡି?	SB – Quarry A	## CTOMEON 112.602063 Tetra Tech NUS Charge No. 6TO 69 / 112600645 QC:													
Depth Sa Sample D	mpled: 🌊	/6 ft bgs 2 / <u>05</u> /2013		Depth 13-18		Field Instrum Sample Ana 1. VOCs 2. E 8. Perchlorate	lyses: DB 3. VPH				or details) es 7. Explosives					
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. uS/cm M5/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments					
1235	16.28	30P/1/5 (PM	300	Initiate purge; c	heck drawdo	wn; adjust flow	rate									
1240	16.43	1. 4	360	Fill flow-through	-ill flow-through cell / monitor parameter readings											
1250	16.45		400	21.0	9.43	0.175	6.61	174.9	8.94	7.22	Clear/coloruss					
1300	16.47	V	W 11		9.96	0.174	6.62	130.1	9.22	14.0	w ₁ u					
1310	16.38	25 PST 5 CPM		£ 2.5	9.88	0.173	6.64	184.8	8.57	6.20	總理所養房 3.55					
1315	16.40	6 B	** #		9.88	0.173	6.63	186,0	8.65	4.33						
1320	16.41	4		23.5	9.86	0.170	6.63	136.9	8.72	3.18	V					
	Reached	Stabilization,	Collect Single													
Acceptance	Criteria: <0.3 ft (c				+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10%	+/- 10%	>10 NTUs						

Tt Form 0009 (modified for CTO-69)

Saturated Screen Volume (gallons) 0.7335 _ (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

^{1.} Pump dial setting (for example: hertz, cycle/min, etc.)

microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



Tetra Tech, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page_ of 1

Project Site Name: Former NASB - Quarry RI Sample ID No.: QRY D9Gwoo18-0812-Site Location: Sample Location: MW-GEY-01B Brunswick, Maine Project No.: CTO WE09 / 112G02063 Sampled By: B. Gennye Domestic Well Data C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: Date: 08/29/12 Color Temp S.C. DO pH ORP **Turbidity** Other Time: 0850 (Visual) (°C) (µS/cm) (mg/L) (S.U.) (mv) (NTU) Method: Low stress (low-flow) Coloruss 9.50 207 7.47 7.38 -283 2.30 PURGE DATA: Date: 08/29/12 Volume Temp S.C. DO рН ORP **Turbidity** Other Method: Low stress (low-flow) Pump Type: Bladde or Peristaltic Sample Tubing / Intake Depth: 25' bas Monitor Reading (ppm): 0.0 Well Casing Diameter/Material: 2in 4in, or 6-in (ID) (PVC)or steel Screen Interval (ft bgs): 13-28 Static Water Level (WL): 25.28 29.79 Total Well Depth (TD): WL & TD Measuring pt.: 784C Sat. Screen Volume(gal): 0.73 Start Purge (hrs): 0755 0845 End Purge (hrs): 50 Total Purge Time (min): Total Vol. Purged (gal): 3,3 SAMPLE COLLECTION INFORMATION: **Analysis** Preservative **Container Requirements** Collected TCL VOCs 4°C / HCL 3 - 40 ml. VOAs Yes No 4°C / Na, G, O2 EDB 2 - 40 ml. VOAs Yes No 4°C/HCL HCL **VPH** 2 - 40 ml. VOAs Yes No EPH 4°C / HCL 2- 1 Liter Amber Yes / No **SVOCs** 4°C 2- 1 Liter Amber Yes / No Explosives (plus Nitroglycerine) 4°C 2- 1 Liter Amber Yes / No Total Metals 4°C / HNO₃ 1 - 1 Liter HDPE Bottle Yes / No Perchlorate 4°C 1 - 125 ml. HDPE Bottle Yes / No Pesticides/PCBs 4°C 2- 1 Liter Amber Yes / No **OBSERVATIONS / NOTES:** Weather: Summ 605 Visual evidence of sheen on purge water - Yes or No If yes, describe: Olfactory evidence of odor - Yes or lo If yes, describe: Thickness of bladder pump well cap above top of riser (TOR) N/A Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle if Applicable: Signature(s): MS/MSD **Duplicate ID No.:**

TŁ	TETRA TE	CH, INC.	PURGE DATA SHEET - "LOW STRESS" GROUNDWATER											
Site Name: Former NASB Brunswick - Quarry Remedial Investigation Sample ID: QRY DAGWONB - 0812-						Tetra Tech NUS Charge No. 112G02063 Page L of L QC: LAB &C (If applicable)								
Depth San Sample D	mpled: 25	ft bgs / 39 /2012	s Screen Int	or Bladder Pump . Depth 18-28 s(Dup	ft bgs	Field Instrum Sample Ana 1. TAL VOCs Nitroglycerine	lyses: 2. EDB 3. \	/PH 4. SVO	Cs 5. EPH (e logbook fo	or details	s)		
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. uS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments			
0755	Start Pur	p 30 PSI	250	Initiate purge; c	heck drawdo	wn; adjust flow	rate							
0300	25.30	1- 11	W. 11	Fill flow-through	cell / monito	or parameter rea	adings					1271		
0805	25.30				9.76	239	7.00	-37.2	6.21	18.3	clear	coloress		
0815	25.32			TYPE TENS	9.50	227	7.18	-25.1	6.77	13.7	- H - F			
0835	25.32				9.49	217	7.25	-24.4	7.23	9.37				
0835	25.32				9.50	212	7.35	-25.9	7.44	5.45		1517		
0840	25.32				9.50	209	7.37	-27.6	7.51	3,67				
0845	25.32		V	3,3	9.50	207	7.38	-28.3	7.47	2,30	1	/		
	Reached	Stabilizala	Calut S											
	W. T. W.													
	Criteria: <0.3 ft (d				±/- 10%	±/- 10%	+/-02511		1/- 10%	<10 NTUo				

TtNUS Form 0009 (modified for CTO 09)

Saturated Screen Volume (gallons) 0.73 (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

- Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Sample ID No .: Former NASB - Quarry Area RI Site Location: Sample Location: (1) Brunswick, Maine Project No.: OTO 69 / 112G00045 Sampled By: [] Domestic Well Data CTO WEO9/112602063 C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: Date: S.C. DO Color Temp ORP **Turbidity** pН Other Time: (Visual) (°C) (mg/L) (S.U.) (mv) (NTU) Method: Low stress (low-flow) eur 90 6.60 224.9 PURGE DATA: Date: Volume Temp S.C. DO ORP 12/2/13 pН Turbidity Other Method: Low stress (low-flow) Pump Type Bladderor Peristaltic Sample Tubing / Intake Depth: Monitor Reading (ppm): Well Casing Diameter/Material: in 4in, or 6-in (ID) / PVO or steel Screen Interval (ft bos): Static Water Level (WL): Total Well Depth (TD): WL & TD Measuring pt.: Sat. Screen Volume(gal): Start Purge (hrs): End Purge (hrs): D Total Purge Time (min): Total Vol. Purged (gal): SAMPLE COLLECTION INFORMATION: **Analysis Preservative Container Requirements** Collected 6°C / HCL **VOCs** 3 - 40 ml vials (Yes) No 6°C / HCL **EDB** 2 - 40 ml vials (es) No VPH 6°C / HCL 2 - 40 ml vials Yes / No EPH 6°C / HCL 2 - 1 liter amber botles es No 6°C **SVOCs** 2 - 1 liter amber botles Yes No 6°C PCBs/Pesticides 2 - 1 liter amber botles Yes No 6°C Explosives (Including Nitroglycerine) 2 - 1 liter amber botles No No 6°C 1 - 125-ml HDPE bottle Perchlorate Yes / No Metals 6°C/HNO₃ 1 - 500 ml HDPE bottle es No **OBSERVATIONS / NOTES:** Visual evidence of sheen on purge water - Yes o No If yes, describe: Olfactory evidence of odor - Yes or If yes, describe: Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle if Applicable: Signature(s): MS/MSD **Duplicate ID No.:**

1	71-	TETRATEC	Н
1	IC		

LOW FLOW PURGE DATA SHEET

PAGE TOF T

PROJECT SITE NAME:

NAS Brunswick / Quarry

WELL ID.:

DAI-MNOIB

PROJECT NUMBER:

CTO 069 / WE09 (112G00645/112G02063)

DATE:

2/2/13

Time	Water Level	Pump Setting(s) ¹	Flow	рН	Sp. Cond.	Temp.	Turb.	DO	ORP	Comments
(Hrs.)	(ft. below TOC)	THE RESERVE OF THE PERSON NAMED IN	(mL/Min.)	(S,U.)	(mS/cm)	(Celsius)	(NTU)	(mg/L)	mV	
1:58	18:13	23051	400	Start / Initial	Water Level					
2:1405			400	3.92	1248	375	25.9	7.185	24480	Chear
2:10	18,11	V	400	657	1159	917	15.2	9.00	238,0	cles
1415	18.12		1	6.51	1156	0.00	7123	8.59	2345	Chear
1420	18,12		3471 0000	6.51	1156	8,97	4.21	3.4Le	2329	Chean
1425	18,012	111		k153	1155	8.87	2.80	7.74	23110	Clex
1430	18,01e	V	V	6,54	1155	9.05	1,89	7.68	229.5	CHAS
1445	18.16	4	4	12.25	1154	885	1.42	6.89	2,44	Clear
1450	18:10	4	V	6.60	156	9,19	101	6.90	224,9	Clear
	•									
			avar ii K		Trans.					
		THE SA STATE OF THE SALES								
Stabilization	n Criteria: 0.3 ft (draw	/down)		± 0.2 SU	± 10%	± 10%	< 10 NTUs	± 10%	± 10%	

¹ Pump Setting(s) refers to dial settings (cycles/min, psi, etc.)

Pump Intake Depth:

25.0

ft TPVC

Sat. Well Volume:
Total Volume Purged

 $\frac{1}{195}$ (2 in = 0.163 gal/ft H₂0)



GROUNDWATER SAMPLE LOG SHEET

		- No. 10					Pa	ge <u></u> of 1	
Project Site Name:	Former NAS	SB - Ouerr	v Di		Sampl	e ID No:	BRYD9G W	anco - 4910	
Site Location:	Brunswick,		упі		Sampl	e I ocation:	MW-GR	1-001A	
Project No.:	CTO WE09		063						
☐ Domestic Well Data	010 11200	TILGOL	000		Sampled By: B.G. C.O.C. No.:			eringer	
[X] Monitoring Well Data					Type of Sample:				
Other Well Type:					[X] Low / Moderate Conc			tration	
[] QA Sample Type:	1177 21	P L	11971		High Concentration				
				JIH .					
SAMPLING DATA:	!	,,,			14/0				
Date: 08/28/12	Color	Temp (°C)	S.C.	DO	рН	ORP	Turbidity	Other	
Time: 1320 Method: Low stress (low-flow)	(Visual)		(µS/cm)	(mg/L)	(S.U.)	(mv)	(NTU)	L n = sett U II	
PURGE DATA:	Colorless	15.78	170	5.61	6.23	1560	0.00		
Date: 08/28/12	Volume	Temp	s.c.	DO	рН	ORP	Turbidity	Other	
Method: Low stress (low-flow)	Aoigina	remp	3.0.	БО	рп	UNP	Turbidity	Other	
				100 0		10.00			
Pump Type: (Bladder) or Peristaltic			2281						
Sample Tubing / Intake Depth: 31 545		Acres 10	REVENUE OF				27 82		
Monitor Reading (ppm): 0.0			10		THE PLAN	W = -			
Well Casing Diameter/Material:	61							V I	
2in 4in, or 6-in (ID) /(PVC)or steel				Ta	72				
Screen Interval (ft bgs): 12-22		9.							
Static Water Level (WL): 18.13	- 77 - 10 - 17		TE T		1 7 7	V			
Total Well Depth (TD): 34.37	e Fill & Live					= 7		i n	
WL & TD Measuring pt.: TPVC									
						2			
		-0.1							
Start Purge (hrs): 1/15						6 R			
End Purge (hrs): 1315	4 (5) (1) (b)		te				T HELLYL		
Total Purge Time (min): 120									
Total Vol. Purged (gal):		A. D. Say	Eng. 11 41	4 .1.1	Dew 8	1 P			
SAMPLE COLLECTION INFORMATION:									
Analysis		Preser	vative		Container	Requirement	is	Collected	
TCL VOCs	ma p j	4°C	/ HCL	3 - 40 ml.	VOAs		W XI	(Yes) No	
EDB		4°C/	1020203 86	2 - 40 ml.	VOAs			Yes No	
VPH	Eur E A	4°C	HCL HC	2 - 40 ml.	VOAs	11 1 9	MEIL, IEIE	Yes / No	
EPH			/ HCL	2- 1 Liter		T-9/5	47	Yes / No	
SVOCs		4	•C	2- 1 Liter	Amber		5 7 5 1	Yes / No	
Explosives (plus Nitroglycerine)	11845.1	4	•C	2- 1 Liter	Amber			(Yes)/No	
Total Metals		4°C /	HNO ₃	1 - 1 Liter	HDPE Bottle	mghiir c	B 35 B	Yes / No	
Perchlorate		4	•C	1 - 125 m	I. HDPE Bottl	е		Yes / No	
Pesticides/PCBs	L K TIN YI	4	•C	2- 1 Liter	Amber			Yes No	
OBSERVATIONS / NOTES:						10.19		115	
Weather: Ah Clandy 805, M Visual evidence of sheen on purge water -	uggy					I THE TANK			
		, describe:							
Olfactory evidence of odor - Yes on (No) If									
Thickness of bladder pump well cap above t		N/A							
Air Supply: Compressed G (Nitrogen) or (Compressed Air								
Comments: Well rechanging Slow	vhy								
Circle if Applicable:					Signature	(s):			
MS/MSD Duplicat	=======								
				14	نے کھیز				
	Jack R	والعزي	* - 2 -	# You		7			

TŁ	TETRA TE	CH, INC.				PURGE DATA SHEET - "LOW STRESS" GROUNDWATER						
	e: <u>Former NA</u> D: <u>QRYD</u> 9G			nedial Investigatio	<u>nc</u>	Tetra Tech NUS Charge No. 112G02063 Page 1 of 1 QC:(If applicable)						
Sample Method: Low Stress (flow) with Peristaltic or Bladder Pump Depth Sampled: *21 ft bgs Screen Int. Depth 12-22 ft bgs Sample Date & Time: \$ /28 /2012 1320 hours (Dup Time) Sampler(s): *3 Caringer Initial WL: 18.13					Field Instrument Group A B C / D (refer to site logbook for details) Sample Analyses: 1. TAL VOCs 2. EDB 3. VPH 4. SVOCs 5. EPH 6. Explosives (plus Nitroglycerine) 7. Perchlorate 8. Total Metals 9. Pesticides/PCBs							
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. uS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Co	omments
1115	1803	३०१ अ	150	Initiate purge; c	heck drawdow	n; adjust flow r	ate				Wate	rlevel
1125	18:70	18 PSI	90	Fill flow-through	n cell / monitor	parameter rea	dings				dropin	Fast.
1135	18.85	16 PSI	50		18,04	181	6.09	127.2	9.21	6.28	Clear	Coloriess
1145	19.02	31 11	-X 11		17.22	173	6.08	143.2	7.69	5.92	"	h
1155	19.11		1		16.99	170	6.12	145.1	6.95	3,66		
1205	19.26		40	- *	16.78	171	6.17	147.4	6.66	2.84		
1315	19.35		44 44		16.81	171	6.20	148.9	6.45	2,45		
1225	19.41	y	V		16.94	171	6.22	149.5	4.34	2.23		
1235	19.54	17 PSI	50		15,57	174	6.22	152.7	7.06	0.18		
1245	19.81	1- 4	55		14.90	171	6.15	158.4	6.42	0.13		
1255	19.92	1695	45		15.59	171	6.23	154.8	6.02	0.00		
1305	20.01	36 36	20 4		15.41	171	6.23	155.1	6.04	0,00		
1315	20.11	1	V	1.6	15.78	170	6.23	156.0	5.61	0.00	1	/
		Reachal	two hour s	une limit - Call	ect Sample							
Acceptance (Criteria: <0.3 ft (d	(rawdown)			+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10mV	+/- 10%	<10 NTUs		

TtNUS Form 0009 (modified for CTO 09)

1.0 Saturated Screen Volume (gallons) (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.

^{3.} Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Page

Project Site Name: Former NASB - Quarry Area RI Sample ID No.: Site Location: Brunswick, Maine Sample Location: Project No.: CTO 69 / 112G00645 Sampled By: [] Domestic Well Data CTO NEO9/ 112607063 C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: 12/3/2013 Date: Color ORP Turbidity pН Other Time: (Visual) (mg/L) (S.U.) (NTU) (mv) Method: Low stress (low-flow) 2-1 **PURGE DATA:** 9.86 5.3. Volume Date: -12-3-2013 Temp S.C. DO pH ORP Turbidity Other 208.8. Method: Low stress (low-flow) Pump Type: Bladder or Peristaltic Sample Tubing / Intake Depth: 20:14 Monitor Reading (ppm): 💍 💍 Well Casing Diameter/Material: 2in, Jin, or 6-in (ID) PVO or steel Screen Interval (ft bgs): Static Water Level (WL): Total Well Depth (TD): WL & TD Measuring pt.: Sat. Screen Volume(gal): Start Purge (hrs): End Purge (hrs): Total Purge Time (min): Total Vol. Purged (gal): SAMPLE COLLECTION INFORMATION: **Analysis** Preservative Container Requirements Collected **VOCs** 6°C / HCL 3 - 40 ml vials Yes No 6°C / HCL EDB 2 - 40 ml vials Yes/No 6°C/HCL **VPH** 2 - 40 ml vials Yes / No EPH 6°C / HCL 2 - 1 liter amber botles Yes/No 6°C 2 - 1 liter amber botles Yes No **SVOCs** 6°C Yes / No PCBs/Pesticides 2 - 1 liter amber botles 6°C Explosives (Including Nitroglycerine) 2 - 1 liter amber botles Yes / No 6°C 1 -125 ml HDPE bottle Perchlorate 250 M4 Yes No Metals 6°C/HNO₃ 1 = 500 ml HDPE bottle Yes No **OBSERVATIONS / NOTES:** Weather: Cloudy, 43 * F
Visual evidence of sheen on purge water - Yes of No If yes, describe: Olfactory evidence of odor - Yes o No If yes, describe: Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle if Applicable: Signature(s): MS/MSD **Duplicate ID No.:**

1			
	Te.	TETRA TECH	

LOW FLOW PURGE DATA SHEET

PAGE OF Z

PROJECT SITE NAME:

NAS Brunswick / Quarry

WELL ID.:

MW-QRY-02

PROJECT NUMBER:

CTO 069 / WE09 (112G00645/112G02063)

DATE:

12/3/2013

Time	Water Level	Pump Setting(s) ¹	Flow	рН	Sp. Cond.	Temp.	Turb.	DO	ORP	Comments
(Hrs.)	(ft. below TOC)		(mL/Min.)	(S.U.)	MS/Cur (ins/cm)	(Celsius)	(NTU)	(mg/L)	mV	
855	15.64			Start / Initial	Water Level					
828	15/15	60	530	7.31	1146	3852	631	714	204.90	Clear
908	15.74	21	405	5,17	11/2	9,66	3,50	5.64	205.80	Clans
918	15.71	2/	405	5,13	1117	9,72	1,98	5.91	208,80	Clear
928	15.74	21	805	5.19	1120	9.65	163	5,78	209.70	Char
938	15.75	21	405	5,20	051.	9,33	140	5.90	210.50	Clear
948	15,75	21	485	5,20	120	8,90	138	6.04	241.65	Clear
9:50-1	4:15 Pump	control	:SSNK							
	1059 Wait		xement o	umO					and the second STE	
1100	15,70	21	405	5.19	,119	8.79	125	6.918	212,2	Clast
1105	15,71	21	405	537	1114	9.74	,/8	6.88	205.0	Clase
(110	15,30	·21	405	5,34	11/2	9.82	127	6.75	205,6	den
1115	15:35	21	465	5134	1/3	9.88	124	6.76	207,4	Clear
1120	15.75	21	405	5.35	1114	9.8/2	126	691	203,8	1625
				II AII EXERCIT AV					T. H. G.	
4 5 V										
			Causa III SV							
1000				110						
Batter -			- Normali, -							
8										
					THE YEAR					
	w souther by									
							基类 企业			

Stabilization Criteria: 0.3 ft (drawdown)

± 0.2 SU

± 10%

± 10% < 10 NTUs

± 10%

± 10%

¹ Pump Setting(s) refers to dial settings (cycles/min, psi, etc.)

Pump Intake Depth:

20,141

ft TPVC

Sat. Well Volume: Total Volume Purged:

1,467 gol

 $(2.in = 0.163 \text{ gal/ft H}_20)$

(gal) L



GROUNDWATER SAMPLE LOG SHEET

Page of _

Project Site Name: Site Location:	Former NAS Brunswick,		y RI		_ Sam	ole ID No.: ole Location	ORYDAG	16 WOOZ-0812 MW. 03	
Project No.: [] Domestic Well Data	CTO WE09	/ 112G02	063	Ш	_ Sam	oled By:	J. Trai	it it	
[X] Monitoring Well Data						C. No.: of Sample:			
[] Other Well Type:	III A VIII DI	276				ntration			
[] QA Sample Type:	DUPC)		D: , E	tration				
		1945 - 1945 1945 - 1946 1946 - 1946							
Date: 8/28/13	Color	Temp	S.C.	DO	pH	ORP	Turbidity	Other	
Time: [325	(Visual)	(°C)	(μS/cm)	(mg/L)	(S.U.)	(mv)	(NTU)		
Method: Low stress (low-flow) Bladdu	OF THE OWNER OF THE OWNER, THE OW		206	0.31	6.09	78.4	4.07		
PURGE DATA:	രിത്ഗിട്ട			dia .					
Date: 8/28/12	Volume	Temp	S.C.	DO	pH	ORP	Turbidity	Other	
Method: Low stress (low-flow)		see a	dd l	low	Mous	109 she	1		
Pump Type: Bladder or Peristaltic						J			
Sample Tubing / Intake Depth: 4.5 on bottom						1			
Monitor Reading (ppm): 0, 2						2,0 100	Elv PE		
Well Casing Diameter/Material:		***	AND THE RESERVE OF THE PERSON		S IF P III MI	10 10 10 10 10 10 10 10 10 10 10 10 10 1	T. Hurs		
2in, 4in, or 6-in (ID) (PVC or steel		11.7		1 1 1 1 1 1	T				
Screen Interval (ft bgs): 5.5 - 10.5						10 10 10 10 10 10 10 10 10 10 10 10 10 1			
Static Water Level (WL): 9.3 7									
Total Well Depth (TD): 5 15.74				7					
					Maria Maria III	123.5			
WL & TD Measuring pt.: TPVC					H-HE				
Sat. Screen Volume(gal): 0.6		10 A 3					1 1111		
Start Purge (hrs): 1235						- part 1			
End Purge (hrs): 1320							Will Tale		
Total Purge Time (min): 45					gall I	THE SHALL	W Tin	4.00	
Total Vol. Purged (gal): 2									
SAMPLE COLLECTION INFORMATION:		E PRODUK				100 Sept. (100 Sept. 100 Sept.	The second second		
Analysis	de fullado, se estados.	Preserv			0	n de la companya de			
TCL VOCs			HCL	0 40 1		Requirement	S	Collected	
				3 - 40 ml.				Yes/No	
EDB				2 - 40 ml.				(Yes) No	
VPH		4°C /		2 - 40 ml.	-			(Yes) No	
EPH		4°C /		2- 1 Liter /				(Yes) No	
SVOCs			C C	2- 1 Liter /				YESYNO	
Explosives (plus Nitroglycerine)			HNO ₃	2- 1 Liter /				(PBS) No	
Total Metals			°C		HDPE Bottl			X es YNo	
Perchlorate Pesticides/PCBs		-	C	THE PERSON NAMED IN	. HDPE Bot	tle		Yes / No	
OBSERVATIONS / NOTES:	A Hillia Palaga	#552545armickin		2- 1 Liter A	-inber	Sergiological process		Yes No	
Weather: を含いか									
/isual evidence of sheen on purge water - Yes o	No If was	describe:							
Offactory evidence of odor - Yes or No If yes,		uescribe.							
Thickness of bladder pump well cap above top of		NA							
Air Supply: Compressed Gas (Nitrogen) or Comp								111 3 111	
Comments:	#								
							9		
Circle if Applicable:				Later Ha	Signature	e(s):	V - 10- V - 10-		
MS/MSD Duplicate ID I	No.:			TEV.	1 1		/	- 10, 2	
aky dagi	MOIDIN	. 400	912		W	\	6		
Ja-10 Idi	W W 01	002	012		1/6	mul		Δ	

Tt	TETRA TE	CH, INC.				PURGE DATA SHEET - "LOW STRESS" GROUNDWATER						
Site Name Sample ID	e: <u>Former NA</u> D: <u>QRYD9G</u>	SB Brunswick	(– Quarry Rer ဒီဩ	nedial Investigatio	<u>n</u>	Tetra Tech NUS Charge No. 112G02063 Page / of / OC: QKYD96WDUP01 -082812- (If applicable)						
Sample Method: Low Stress (flow) with Peristaltic of Bladder Pump Depth Sampled: 4/5' on John ft bgs Screen Int. Depth 5.5-10.5 ft bgs Sample Date & Time: 6/28/2012 1325 hours 0000 (Dup Time) Sampler(s):					Field Instrument Group A) B/C/D (refer to site logbook for details) Sample Analyses: 1. TAL VOCs 2. EDB 3. VPH 4. SVOCs 5. EPH 6. Explosives (plus Nitroglycerine) 7. Perchlorate 8. Total Metals 9. Pesticides/PCBs					(plus		
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. uS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments	
1235	9.27			Initiate purge; ch	neck drawdov	vn; adjust flow r	ate					
1240	- F			Fill flow-through	cell / monitor	r parameter rea	dings					
1245	9.32		250		15:54	192	5.89	971	1.49	32.3		
1250	9.32				15.13	194	5.92	96.4	0.99	22.1		
1255	9.32				1498	198	5.97	88.3	0.73	18.0	200 F 10 Kg = 113	
1300					14.63	201	5.99	79.2	0.47	11.8		
1305			200		14.60	203	6.01	786	0.44	9.97		
1310					14.79	204	6.01	76.8	0.35	2.91		
1315					14.79	205	6.05	75.7	6.29	3.49		
1320				2	14.88	206	6.09	78.4	0.31	427		
1325			T	arameter	stable	/collec	t sam	ple				
- N	81				18.11							
									19-24	- 2020/04 c		
24			32 3									
						10000						
Acceptance C	riteria: <0.3 ft (d	rawdown)	-2		+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10mV	+/- 10%	<10 NTUs		

TtNUS Form 0009 (modified for CTO 09)

0.6 Saturated Screen Volume (gallons) (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

+/- 10%

<10 NTUs

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Page_i of _i

Project Site Name: Site Location: Project No.: [] Domestic Well Data [X] Monitoring Well Data [] Other Well Type: [] QA Sample Type:	Former NA Brunswick, OTO 09/4	Maine 12000645	-		Sample ID No.: Sample Location: Sampled By: C.O.C. No.: Type of Sample: [X] Low / Model [] High Concent		rate Concentration	
SAMPLING DATA:				ne de la				
Date: 12/02/13	Color	Temp	S.C.	DO	рН	ORP	Turbidity	Other
Time: 1650	(Visual)	(°C)	(#S/cm)	(mg/L)	(S.U.)	(mv)	(NTU)	
Method: Low stress (low-flow)	clear	8,57	0,201	1.09	6.21	48.5	27.5	
PURGE DATA:								
Date: 12/2/13	Volume	Temp	S.C.	DO	pH	ORP	Turbidity	Other
Method: Low stress (low-flow)								
Pump Type: Bladder or Peristaltic								
Sample Tubing / Intake Depth: 💝 9						1137		
Monitor Reading (ppm):								
Well Casing Diameter/Material:	A = 20 - 2003							
2in, 4in, or 6-in (ID) / PVC or steel		e entern						
Screen Interval (ft bgs): 5,5-10,5								
Static Water Level (WL): 8.07							+ +	
1/10//	4				7600-		-	
-0							+ +	
	_				ļ			
Sat. Screen Volume(gal): 8.81.5								
Start Purge (hrs): 1445								
End Purge (hrs): 1645								
Total Purge Time (min): 120								
Total Vol. Purged (gal): 🎏 3								7-11-6
SAMPLE COLLECTION INFORMATION:						Tilling to a seri		
Analysis		Preser	vativa		Container	Requirement		Collected
VOCs			HCL	3 - 40 ml v		nequirement	3	77
			HCL			N-0-1		(es) No
EDB				2 - 40 ml v				(Yes)/ No
VPH			HCL	2 - 40 ml v				Yes / No
EPH SVOCs		6°C /	C		mber botles			Ves / No
PCBs/Pesticides			C		mber botles			Ves / No
Explosives (Including Nitroglycerine)	erwen zen		c	7,000	mber botles			Yes No
Perchlorate			C	- 4	mber botles HDPE bottl		7	Yes / No
Metals		6°C /	-		HDPE bottl			Yes / No
OBSERVATIONS / NOTES:								
Weather: Cloudy, Drizzle, 308 Visual evidence of sheen on purge water - Yo Olfactory evidence of odor - Yes or No If y Air Supply: Compressed Gas (Nitroged) or Co Comments: Control box leaving, Call	es, describe: ompressed Air			ant		4.2		
Circle if Applicable			en mandanan	600 m. 238460	Cigrotura	(a):		
Circle if Applicable: MS/MSD Duplicate	ID No.:		nal uppnestuff		Signature	3.1	3-	

TŁ	TETRA TE	CH, INC.				PURGE DATA SHEET - "LOW STRESS" GROUNDWATER							
Site Name Sample II	e: <u>Former NA</u> D: <u>QRYD4</u> -	SB – Quarry . GW03 - 1213	Area Remedia	I Investigation		CTOUGO9 / 1/2 GC 2 O G 3 Tetra Tech NUS Charge No. GTO 69 / 112 GO 9 GTO 69 / 112 G							
Depth Sai Sample D	mpled: 2	<u>৭ </u>	with Peristaltic s Screen Int 1650 hours	or Bladder Pump Depth(Dup) בלft bgs Time)	Field Instrum Sample Ana 1. VOCs 2. E 8. Perchlorate	lyses: DB 3. VPH				or details) les 7. Explosives		
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. - uS/cm -mS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments		
1445	8,08	CPM 4/40 PSI	2/50	Initiate purge; o	heck drawdo	own; adjust flow	rate				ange		
1450	8.10		1- 11	Fill flow-through	n cell / monito	or parameter rea	adings				130		
14.55	8.12		74 ml		7.75	0.204	6.52	84.8	2.63	1000	Turbid forms		
1505	8.12		In L		8.10	0.201	6.39	78.8	2.74	1000	11, 11		
1515	8.12				8.42	0.198	6.34	73.8	2.10	896			
1525	8.12				8.62	0.201	6.29	64.1	1.52	504			
1535	8.12				8.64	0.202	6.25	62.7	1.23	287	Little Tubid loringe		
1545	8.12			21.5	8.66	0,201	6.23	64.8	1.07	187	16 11		
1555	8.12			2 25 303	8.74	0.300	6.21	67.2	1.14	108	1		
1605	8.12				8.76	0,201	6.20	68.9	1.11	77.6	Slighty Turbad		
1615	8.12				8.65	0.302	6.20	69.2	1.12	52.4	23 11		
1625	8112				7.95	0.202	6.18	72.6	1173	39.0			
1635	812				7.64	0,201	6.19	72.2	1.31	33.0			
1645	8.12 Reached	two hour	Proje limit	≈ 3,0	8.57	0.201	6.21	48.5	1.09	27.5	V		
			-					M.					
Acceptance C	Criteria: <0.3 ft (d	drawdown)	355973		+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10%	+/- 10%	>10 NTUs			

Tt Form 0009 (modified for CTO 69)

Saturated Screen Volume (gallons) 0.815 (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Page f of

Project Site Name: Former NASB - Quarry RI Sample ID No .: 0 RY D9 6W004 - 0812 Site Location: Sample Location: A MUDGEY-04 Brunswick, Maine Project No.: Sampled By: CTO WE09 / 112G02063 J. Waut [] Domestic Well Data C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: ∏ High Concentration SAMPLING DATA: Date: 8/29/2 Time: 09/3 Color Temp S.C. ORP Hq **Turbidity** Other (Visual) (°C) (µS/cm) (S.U.) (mg/L) (NTU) (mv) Method: Low stress (low-flow) clear 13.53 257 Bladder 0.19 6 289 6754 3-05 **PURGE DATA:** colores Date: 8/29/12 S.C. Volume Temp DO ORP Turbidity Other Method: Low stress (low-flow) hope Pump Type: Bladder or Peristaltic Sample Tubing / Intake Depth: ~ Jak bottom Monitor Reading (ppm): 1 Well Casing Diameter/Material: 2in 4in, or 6-in (ID) / PVC or steel Screen Interval (ft bgs): 8-16 Static Water Level (WL): 9,35 Total Well Depth (TD): 18.94 WL & TD Measuring pt.: \ PVC Sat. Screen Volume(gal): 1.3 Start Purge (hrs): 0823 End Purge (hrs): Total Purge Time (min): 47 min Total Vol. Purged (gal): SAMPLE COLLECTION INFORMATION: **Analysis** Preservative **Container Requirements** Collected 4°C / HCL TCL VOCs 3 - 40 ml. VOAs YES No 4°C / Na₂8₂0₃ 2 - 40 ml. VOAs **EDB** Yes / No 4°C/HCL HCL **VPH** 2 - 40 ml. VOAs Ves No 4°C / HCL EPH 2- 1 Liter Amber Yes No 4°C **SVOCs** 2- 1 Liter Amber Yes No 4°C Explosives (plus Nitroglycerine) 2- 1 Liter Amber Yes No 4°C / HNO₃ Total Metals 1 - 1 Liter HDPE Bottle Yes No 4°C Perchlorate 1 - 125 ml. HDPE Bottle Yes 7 No Pesticides/PCBs 4°C 2- 1 Liter Amber Yes No OBSERVATIONS / NOTES: Weather: 70° SVN Visual evidence of sheen on purge water - Yes or No) If yes, describe: Olfactory evidence of odor - Yes of No If yes, describe: Thickness of bladder pump well cap above top of riser (TOR) NA Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle If Applicable: Signature(s): MS/MSD **Duplicate ID No.:**

ŧ	TETRA TE	CH, INC.				PURGE DATA SHEET - "LOW STRESS" GROUNDWATER						
Site Nam Sample II	e: Former NA D: <u>ORY DPG</u>	SB Brunswick NOO4 - OS12	c – Quarry Rer	nedial Investigation	<u>on</u>	Tetra Tech NUS Charge No. 112G02063 Page /_ of (If applicable)						
Sample Method: Low Stress (flow) with Peristaltic of Bladder Pump Depth Sampled: 2 af of the ft bgs Screen Int. Depth 8-16 ft bgs Sample Date & Time: 8 /29 /2012 0915 hours (Dup Time) Sampler(s): Traud				Field Instrument Group A B / C / D (refer to site logbook for details) Sample Analyses: 1. TAL VOCs 2. EDB 3. VPH 4. SVOCs 5. EPH 6. Explosives (plus Nitroglycerine) 7. Perchlorate 8. Total Metals 9. Pesticides/PCBs					(plus			
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. uS/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments	
6823	9.35			Initiate purge; c	heck drawdov	vn; adjust flow	rate					
0825				Fill flow-through		r parameter rea	adings					
0830	9.42		350		13.75	247	6.11	88.0	0.40	38.5		
0835	9.47				13.57	248	6.07	83.7	0.25	37.1		
0840	9.47		300		13.50	254	6.15	75.2	0.24	24.9		
0845	9.47				13.57	258	6.23	67.8	0.23	14.0		
0850	9.41				1356	257	6.26	67.1	0,19	9.32		
0855	9.42			2	13.54	258	6.25	67.7	6.19	(e.602		
0900	9.47				13.52	258	6.29	66.1	0.01	3.36		
0905	9.47				13.51	257	6.28	67.5		3.25		
0910	9,47			3	13.53	257	6.29	67.4	0.17	a.89		
0915			+	# Haro	meters	stable.	collec	same	re			
			Weight									
						N 145		e e e e e e e e e e e e e e e e e e e	G= 10 3			
Acceptance C	Criteria: <0.3 ft (d	lrawdown)	III. IS W. IS	5 5 = n 5	+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10mV	+/- 10%	<10 NTUs		

TtNUS Form 0009 (modified for CTO 09)

1.13 Saturated Screen Volume (gallons)_ (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Sample ID No.: Former NASB - Quarry Area RI Site Location: Sample Location: MI Brunswick, Maine Project No.: CTO 60 / 112G00045 Sampled By: [] Domestic Well Data CTO WEO9 / 112602063 C.O.C. No.: [X] Monitoring Well Data Type of Sample: Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: Date: Temp Color S.C. DO ORP **Turbidity** pH Other Time: (°C) (Visual) (µS/cm) (mg/L) (S.U.) (mv) (NTU) Method: Low stress (low-flow) 3443 5 Mal 12.0 721 Ferral **PURGE DATA:** 245 136 0.06 Date: 12/4/2013 Volume S.C. DÒ ORP Temp pН **Turbidity** Other Method: Low stress (low-flow) Pump Type: Bladder or Peristaltic 14.70 Sample Tubing / Intake Depth: Monitor Reading (ppm): Well Casing Diameter/Material: 2in 4in, or 6-in (ID) / PVC or steel Screen Interval (ft bgs): Static Water Level (WL): Total Well Depth (TD): WL & TD Measuring pt.: Sat. Screen Volume(gal): Start Purge (hrs): End Purge (hrs): Total Purge Time (min): Total Vol. Purged (gal): SAMPLE COLLECTION INFORMATION: **Analysis** Preservative **Container Requirements** Collected 6°C / HCL **VOCs** 3 - 40 ml vials Yes No 6°C / HCL **EDB** 2 - 40 ml vials Yes / No **VPH** 6°C / HCL 2 - 40 ml vials Yes / No 6°C/HCL **EPH** 2 - 1 liter amber botles Yes / No 6°C **SVOCs** 2 - 1 liter amber botles Yes No 6°C PCBs/Pesticides 2 - 1 liter amber botles Yes / No 6°C Explosives (Including Nitroglycerine) 2 - 1 liter amber botles Yes / No 6°C 1 -4257ml HDPE bottle 250 ml Perchlorate Yes / No 6°C / HNO₃ Metals 1 - 500 mHDPE bottle Yes / No **OBSERVATIONS / NOTES:** Weather: Cloudy 43 F*
Visual evidence of sheen on purge water - Yes or No If yes, describe: Olfactory evidence of odor - Yes or No If yes, describe: Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle if Applicable: Signature(s): March MS/MSD **Duplicate ID No.:**

TŁ	TETRA	TECH

LOW FLOW PURGE DATA SHEET

PAGE 2 OF 2

PROJECT SITE NAME:

PROJECT NUMBER:

NAS Brunswick / Quarry

WELL ID.:

CTO 069 / WE09 (112G00645/112G02063)

DATE:

Time	Water Level	Pump Setting(s) ¹	Flow	pH	Sp. Cond.	Temp.	Turb.	DO	ORP	Comments
(Hrs.)	(ft. below TOC)	•	(mL/Min.)	(S:U.)	(mS/cm) _e	(Celsius)	(NTU)	(mg/L)	mV	
13/12	5,80	450170			Water Level					. /
1370	5.91	17'	430	6,05	1/61	9.35	108,0	1.55	sale	types
330	5.93	17	430	10.09	1149	9.21	48.33	1017	10409	Cloudy
1340	5.91	17	430	6,09	141	9.07	15.91	175	75.1	Clear
1350	5.91	19	445	6,08	138	9.26	11.70	164	70.60	clear
20014		19	445	6.08	1137	8,98	9.87	:43	68,70	
1410	5.91	19	455	4,08	1136	8,92	7.48	164	665	chest
		E ikowa swak					E HELECHE			
					IN ELITE					
							2.31			
		ana, 4 Jan								
								100		
					EN EV					
-X120±8										
- with the										
Committee Commit										
			i para de la Y							
						سوي الأرا				
				a program						
	Constitution of the control of the c									

¹ Pump Setting(s) refers to dial settings (cycles/min, psi, etc.)

14.20' **Pump Intake Depth:**

ft TPVC

Sat. Well Volume: Total Volume Purged: 2

 $(2 in = 0.163 gal/ft H_20)$



GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Site Location:	Former NAS Brunswick,	Maine	严勤 多素		Sampl		MW-0RY-05			
Project No.:	CTO 60 / 1:			Y E	Sampled By: B, G			linger		
[] Domestic Well Data[X] Monitoring Well Data[] Other Well Type:[] QA Sample Type:	CTO WEOG	1126020	063		[X] L	of Sample:	rate Concer	Concentration		
SAMPLING DATA:				2 140		9.1 001.001.				
Date: 12/4/13	I Ou	r 					STATE OF THE			
Time: 1405	Color (Visual)	Temp (°C)	S.C.	DO (mg/L)	pH (S.U.)	ORP	Turbidity (NTU)	Other		
Method: Low stress (low-flow)	Clear	9.91	0,494	0,51	6.82	(mv)	7.95			
PURGE DATA:			0, 7, 7	0,37	1 6.00-1	જ.	1 475			
Date: 12/4/13	Volume	Temp	S.C.	DO	рН	ORP	Turbidity	Other		
Method: Low stress (low-flow)								Outer		
Pump Type: Bladder or Peristaltic							WEEK STORY			
Sample Tubing / Intake Depth: 214' bas			10000							
Nonitor Reading (ppm): 0.0										
Well Casing Diameter/Material:										
2in, 4in, or 6-in (ID) (PVC or steel							T			
					100					
Static Water Level (WL): 6.04										
Total Well Depth (TD): 21.07										
VL & TD Measuring pt.: TPVC										
Sat. Screen Volume(gal): 1.630					125.0					
Start Purge (hrs): 1305										
End Purge (hrs): 1400										
Total Purge Time (min): 55										
Total Vol. Purged (gal):										
SAMPLE COLLECTION INFORMATION:										
Analysis		Preser	vative		Container	Requiremen	s	Collected		
/OCs		6°C	/HCL	3 - 40 ml v	3.00			Yes/ No		
EDB .		6°C	HCL	2 - 40 ml v	BARRY STATE OF			(Yes) No		
/PH		6°C		2 - 40 ml v				Yes / No		
PH					mber botles			(Yes)/No		
SVOCs		6	·C	2.00	mber botles			(Yes) No		
PCBs/Pesticides	Value (6	•C	2 - 1 liter a	mber botles	¥3		(Yes)/No		
xplosives (Including Nitroglycerine)		6	C	2 - 1 liter a	mber botles	×3		(Yes) No		
Perchlorate	Kon all all all		·C	70.0	HDPE bottle		Oml)	Yes / No		
Metals		6°C /	HNO₃	1 - 500 ml	HDPE bottle	×3 (25	(IM C	(Yes) No		
DBSERVATIONS / NOTES:		and the second			F-12	n en la				
Veather: Mostly Sunny Lou 40's / Visual evidence of sheen on purge water - Ye of No If ye ir Supply: Compressed Gas (Nitrogen) of Contemporaries:	s or No If ye s, describe:	s, describe	ð:							
Circle if Applicable:				1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 /	Signature	(e)·				

TŁ	TETRA TE	ECH, INC.				PURGE DATA SHEET - "LOW STRESS" GROUNDWATER									
	e: <u>Former NA</u> D: <u>ORYD9- (</u>		Area Remedial	Investigation		CTOMEON 112.602063 Tetra Tech NUS Charge No. GTO 09 / 112600645 Page 1 of QC: YES (If applicable)									
Depth Sa Sample D	Sample Method: Low Stress (flow) with Peristaltic or Bladder Pump Depth Sampled: 214 ft bgs Screen Int. Depth 9-19 ft bgs Sample Date & Time: 12/04/2013 1405 hours — (Dup Time) Sampler(s): Reginger Clock Water Penth Pump Dial 1 Pump Bate Cum, Volume Temp						Field Instrument Group A B / C / D (refer to site logbook for details) Sample Analyses: 1. VOCs 2. EDB 3. VPH 4. EPH 5. SVOCs 6. PCBs/Pesticides 7. Expl 8. Perchlorate 9. Metals								
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. ConduS/em MS/Cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments				
1305	6.08	CPM5/2015I	360	Initiate purge; c	heck drawdo	own; adjust flow	rate								
1310	6.08	","	400	Fill flow-through	n cell / monito	or parameter rea	adings				ILSHAD ON EAST				
1320	6.08		300		9.71	0.509	6.81	9.3	0.85	106	little cloudy				
1330	6.08		" "		9.75	0.505	6.83	6.7	0.65	51.9	Slightly Cloudy				
1340	6.08			2 3,0	9.88	0.500	6.80	9.8	0.55	27.8	Clear/coloruss				
1345	6.08				9.83	0.498	6.81	7.3	0.56	16.7	W II				
1350	6.08				9.83	0.497	6.81	4.7	0.54	13.0					
1355	6.08				9.90	0.495	6.82	3.6	0.50	9.73					
1400	6.08	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	<u> </u>	≈ 4.0	9.91	0.494	6.82	2.1	0.51	7.95	V				
	Reached	Shhlizative,	Collet Suple												

Acceptance Criteria: <0.3 ft (drawdown)

+/- 10%

+/- 10%

+/- 0.2 S.U. +/- 10% +/- 10%

>10 NTUs

Tt Form 0009 (modified for CTO-89)

Saturated Screen Volume (gallons) 1.630 (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Project Site Name: Sample ID No.: Former NASB - Quarry Area RI Site Location: Sample Location: Brunswick, Maine Project No.: CTO-60 / 112G00645 Sampled By: □ Domestic Well Data CTO LEO9 | 1126-02663 C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: Date: Color Temp SC DO ORP **Turbidity** pH Other (°C) Time: (Visual) (µS/cm) (S.U.) (mg/L) (mv) (NTU) Method: Low stress (low-flow) 4 1 4 **PURGE DATA:** 1080 230.4 5 ,87 5.61 Date: 143/2013 Volume S.C. DO ORP **Turbidity** Temp Other Method: Low stress (low-flow) Pump Type, Bladde or Peristaltic Sample Tubing / Intake Depth: Monitor Reading (ppm): Well Casing Diameter/Material: (ID) / PVC or steel Screen Interval (ft bgs): Static Water Level (WL): Total Well Depth (TD): TPUC WL & TD Measuring pt.: Sat. Screen Volume(gal): Start Purge (hrs): 1455 End Purge (hrs): Total Purge Time (min): 5,0 Total Vol. Purged (gal): SAMPLE COLLECTION INFORMATION: **Analysis** Preservative **Container Requirements** Collected 6°C / HCL **VOCs** 40 ml vials Yes No 6°C/HCL EDB 2 - 40 ml vials Yes/ No 6°C/HCL 2 - 40 ml vials VPH Yes No 6°C/HCL 2 - 1 liter amber botles EPH Yes No 6°C **SVOCs** 2 - 1 liter amber botles Ves No 6°C PCBs/Pesticides 2 - 1 liter amber botles Yes No 6°C No. Explosives (Including Nitroglycerine) 2 - 1 liter amber botles 6°C 1 - 125 ml HDPE bottle Yes No Perchlorate 6°C/HNO₃ Metals 1 - 500 ml HDPE bottle Yes No **OBSERVATIONS / NOTES:** Weather: ハール・リング・リング・リング・Visual evidence of sheen on purge water - Yes or No) If yes, describe: Olfactory evidence of odor - Yes or No If yes, describe: Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Signature(s): Circle if Applicable: Salley. MS/MSD Duplicate ID No.:

-	TŁ	TETRA TECH	

LOW FLOW PURGE DATA SHEET

PAGE Z OF Z

MV-2RV-086

1.13/13

PROJECT SITE NAME:

NAS Brunswick / Quarry

WELL ID.:

PROJECT NUMBER:

CTO 069 / WE09 (112G00645/112G02063)

DATE:

Time	Water Level	Pump Setting(s) ¹	Flow	рН	Sp. Cond.	Temp.	Turb.	DO	ORP	Comments
(Hrs.)	(ft:(below TOC)		(mL/Min.)	(S;U.)	(mS/cm)	(Celsius)	(NTU)	(mg/L)	mV	
1315	17.28	20	420	Start / Initial						
325	17.28	20	420	6.07	1/22	9.73	77.80	7,32	221,60	C/ousy
1335	17.2	65	420	5,78	1091	9.62	20.20	7,02	223:2	clear
1345	17.25	70	420	5,69	1085	9,61	8.88	6.98	225.7	Clear
1355	17,25	20	420	5.65	1083	9.62	5,04	4.95	225,10	clear
1405	17.26	20	420	5,69	1082	9.62	3,47	6,81	2363	clear
145	17,25	20	420	5.102	1031	9.60	2.09	6.82	230,2	Clar
1425	17.25	20	40	5.61	.080	9,50	1.34	6,87	230.4	clist
			Shariff							Well will break a
		THE PARK								
				vali satang - c				H. G. 12V		
	illi a energio v	Transfer of the second								
					- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1					
						Wage Tie				
1 0 0 0 0										
Problem A		10 M = 11 M								

Stabilization Criteria: 0.3 ft (drawdown) ¹ Pump Setting(s) refers to dial settings (cycles/min, psi, etc.)

23,47 Pump Intake Depth:

ft TPVC

± 0.2 SU

± 10%

Sat. Well Volume:

Total Yolume Purged:

< 10 NTUs

± 10%

± 10%

0.163 gal/ft H₂0)

± 10%



GROUNDWATER SAMPLE LOG SHEET

Page_ ' of _ !

Project Site Name: Former NASB - Quarry Area RI Sample ID No.: QRYD9-6W07-1213 Site Location: Brunswick, Maine Sample Location: MW- 0RY-07 Project No.: OTO 09 / 112000045 Sampled By: B. Geringer □ Domestic Well Data C704E09/112602063 C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: Date: 12/04/13 Color Temp S.C. DO ORP **Turbidity** pH Other Time: 0945 (°C) (Visual) (mg/L) (S.U.) (mv) (NTU) Method: Low stress (low-flow) clear 8.66 0.201 0.47 7.77 -1aa.7 9.6 PURGE DATA: Date: 12/4/13 Volume Temp S.C. DO ORP pΗ **Turbidity** Other Method: Low stress (low-flow) Pump Type Bladder or Peristaltic Sample Tubing / Intake Depth: 227 b; 5 Monitor Reading (ppm): 0,0 Well Casing Diameter/Material: 2in 4in, or 6-in (ID) (PVC)or steel Screen Interval (ft bgs): 7 17-27 Static Water Level (WL): 3.72 Total Well Depth (TD): 29.46 WL & TD Measuring pt.: TPIC Sat. Screen Volume(gal): 1.630 Start Purge (hrs): 0840 0940 End Purge (hrs): Total Purge Time (min): 60 Total Vol. Purged (gal): 23.5 SAMPLE COLLECTION INFORMATION: **Analysis** Preservative **Container Requirements** Collected 6°C / HCL **VOCs** 3 - 40 ml vials Yes No 6°C / HCL EDB 2 - 40 ml vials (Yes) No VPH 6°C/HCL 2 - 40 ml vials Yes No 6°C / HCL **EPH** 2 - 1 liter amber botles Yes No 6°C **SVOCs** 2 - 1 liter amber botles Yes No PCBs/Pesticides 6°C 2 - 1 liter amber botles Yes No Explosives (Including Nitroglycerine) 6°C 2 - 1 liter amber botles (es/No 6°C Perchlorate 1 - 125-ml HDPE bottle 1-250m1 Yes / No 1 - 500 ml HDPE bottle Metals 6°C / HNO₃ 1-25001 (Yes) No **OBSERVATIONS / NOTES:** Weather: Sunny upper 20's Visual evidence of sheen on purge water - Yes or No If yes, describe: Offactory evidence of odor - Yes or No If yes, describe: Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle if Applicable: Signature(s): MS/MSD **Duplicate ID No.:**

Tt	TETRA TE	CH, INC.				PURGE	DATA SH	IEET - "LO	OW STRE	SS" GRO	UNDWATER
Site Name Sample II	e: <u>Former NA</u> D: <u>QRYD4</u>	SB – Quarry / - (Area Remedia 3	Investigation		Tetra Tech N	IUS Charge	270 WE O No. 670 6	9 112G020 9 112G006		Page of
Depth San Sample D	mpled: _ を み	2 / <u>04</u> ft bgs 2 / <u>04</u> /2013		orBladder Pump Depth 17-27 Dup		Field Instrum Sample Ana 1. VOCs 2. E 8. Perchlorat	lyses: DB 3. VPH				or details) es 7. Explosives
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. - uS/cm - Ms/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments
0840		CPM4/30P5I	400			own; adjust flow					
0850	4.45	CPM4 20 PSI	360	Fill flow-through	cell / monito	or parameter rea	adings		101		
0900	4.78	CPM5/20 PSI	300		8.60	0,208	7.66	-78,9	0.82	44.8	Slightly Cloudy
0910	4.72	10 11	220		8.52	0,204	777	-104.5	0.63	40.1	to te
0915	4.72		w H		8.51	0.204	7,74	-109.9	0.54	26.6	clear/colorless
0920	4.72				8.55	0.203	7.75	-114.4	0,50	18.1	vi ti
0925	4.72				8.60	0.202	7.76	-114.2	0,51	14.4	
0930	4.72				8.66	0.202	7.76	=117.5	0.48	12.0	
0935	4.72		14 B		8.66	0.201	7.76	-120.7	0,47	11.4	
0940	4.72	1	1	≈ 3.5	8.66	0.201	7.77	-122.7	0,47	9.6	· ·
	Reached	Stubilization,	Collect Simple								
	Criteria: <0.3 ft (+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10%	+/- 10%	>10 NTUs	

Tt Form 0009 (modified for CTO-99)

1.630 Saturated Screen Volume (gallons)_ (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

^{1.} Pump dial setting (for example: hertz, cycle/min, etc.)

microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Page 1 of 2

ual)	Temp (°C)	S.C. (μS/cm)	DO (mg/L)	Type [X] [] H pH (S.U.)	C. No.: of Sample: Low / Moder igh Concent ORP (my)	ration Turbidity	ntration Other
ual)	(°C)	(μS/cm)	(mg/L)	(S.U.)	100		Other
ual)	(°C)	(μS/cm)	(mg/L)	(S.U.)	100		Other
8	89	423	ATTERNATION AND ADDRESS OF THE PARTY OF THE	The state of the s	(mv)	(A reserve to	
8	89		46	2 4 4 4		(NTU)	
-	-	-11 12	THE PERSON NAMED IN COLUMN	Hitte	292	124	Allega metados de la color de
me i	emp	S.C.	830 DO	4.15	790./	180	0.1
1	The state of the s	5.0.	50	pН	URP	Turbidity	Other
						-	
333							
	1			1			
		1					
1							
					MOC MATTERNANCE.		
(1)	$\neg \uparrow$	(E)					
						1	
9							5 Sp. 194
	_		-				Mar.
							Al
							_
0							
	ds.ii su						
F	Preserv	ative		Container	Requirement	8	Collected
	6°C / I	HCL	3 - 40 ml vi	ials			Yes / No
	6°C / I	HCL	2 - 40 ml vi	ials			Yes / No
	6°C / I	HCL	2 - 40 ml vi	ials			Yes / No
	6°C /	HCL	2 - 1 liter a	mber botles	s		Yes / No
			2 - 1 liter a	mber botles			(Yes) No
							Yes No
							Yes / No
					THE RESERVE OF THE PERSON NAMED IN		(es) No
stunes and output	6°C/F	INU3	1 ~600 π π11	HOPE bott!	e 750 %	V.	Yes/ No
		Preserv 6°C /	Preservative 6°C / HCL	Preservative 6°C / HCL 3 - 40 ml v 6°C / HCL 2 - 40 ml v 6°C / HCL 2 - 1 liter a 6°C 1 - 125 ml 6°C 1 - 125 ml	Preservative Container 6°C / HCL 3 - 40 ml vials 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 1 liter amber bottles 6°C 1 - 125 ml HDPE bottl 6°C / HNO ₃ 1 - 560 ml HDPE bottl	Preservative Container Requirements 6°C / HCL 3 - 40 ml vials 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 1 liter amber bottles 6°C 1 - 125 ml HDPE bottle 2.5 0 ml 6°C / HNO ₃ 1 - 560 ml HDPE bottle 2.5 0 ml	Preservative Container Requirements 6°C / HCL 3 - 40 ml vials 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 1 liter amber botles 6°C 1 - 126 ml HDPE bottle 250 ml 6°C / HNO ₃ 1 - 500 ml HDPE bottle 250 ml

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LOW FLOW PURGE DATA SHEET

MW-284 -08 08

PROJECT SITE NAME: PROJECT NUMBER:

NAS Brunswick / Quarry

CTO 069 / WE09 (112G00645/112G02063)

WELL ID.:

DATE:

Time	Water Level	Pump Setting(s) ¹	Flow	рН	Sp. Cond.	Temp.	Turb.	DO	ORP	Comments
(Hrs.)	(ft. below TOC)	THE RESERVOIS CONTRACTOR	(mL/Min.)	(S.U.)	(mS/cm)	(Celsius)	(NTU)	(mg/L)	∜mV	
933	4.74	70/31	355	Start / Initial						
838	15,00	20	355	4,50	1077	8.86	16.90	880	2375	Claydy
348	5,11	20	355	4,30	1073	8.76	8.48	8/18	248,0	Clear
858	5,10	20	358	4,21	1072	8.77	2,92	8.15	465.7	Clear
908	5,15	70 20	22	416	1072	8,78	1.67	816	274.10	Clear
218	5,16	20	355	4.110	1072	8,90	125	832	282.10	Clare
856	5.16	20	355	4,15	1072	8.89	17030	8,30	290.10	chat
			1 2 2							
ts										
			Martin 5		a muligra a					
				V = 15						
				100000000000000000000000000000000000000						
# #									To v All-	
		17 11 11			******					
14						1 275522				
								300		
100 C 100										
						- 44 E.W				
MERITE.						Bichan I I				THE SAME STATE OF THE SAME STA

Stabilization Criteria: 0.3 ft (drawdown)

± 0.2 SU

± 10%

± 10% < 10 NTUs ± 10%

± 10%

¹ Pump Setting(s) refers to dial settings (cycles/min, psi, etc.)

Pump Intake Depth:

14,25 ft TPVC Sat. Well Volume:

 $(2 in = 0.163 gal/ft H_20)$

gal L

Total Volume Purged:



GROUNDWATER SAMPLE LOG SHEET

							Pa	ge of _	
Project Site Name:	Former NAS	SB - Quan	rv Area Ri		Samol	le ID No.:	Quena	-GW09-121	
Site Location:	Brunswick,					e Location:	MW-084-09		
Project No.:	CTO 60 / 1:		Nejea (Te)			led By:	B. Geringer		
[] Domestic Well Data	CTO WEOD	1126020	06.3	H W V	C.O.C	Pi Germa	<u> </u>		
[X] Monitoring Well Data		B			Type o				
[] Other Well Type:				Tayet =	[X] L	ow / Moder	ate Concer	tration	
[] QA Sample Type:			8-fili +47/		[] Hig	gh Concenti	ration		
SAMPLING DATA:				The state of the s					
Date: 12/05/13	Color	Temp	SC	DO	pH	ORP	Turbidity	Other	
Time: 0945	(Visual)	(°C)	S.C.	(mg/L)	(S.U.)	(mv)	(NTU)	Other	
Method: Low stress (low-flow)	Clear	9.93	0.057	4.47	5.41	253,3	4.70		
PURGE DATA:						0.002			
Date: 2/05/13	Volume	Temp	S.C.	DO	pH	ORP	Turbidity	Other	
Method: Low stress (low-flow)					The state of				
Pump Type: Bladder)or Peristaltic		7.2			(E1 = 18)		OVER THE REST		
Sample Tubing / Intake Depth: 2/0,5 bgs		1	1 3 1 3		5 87 11	VALUE OF STREET			
Monitor Reading (ppm): 0.0					27				
Well Casing Diameter/Material:					A STATE OF				
			2 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	William III	1				
2in, 4in, or 6-in (ID) (PVC) or steel				No. 100		80 18 - V			
Screen Interval (ft bgs): 6-13					III. A ARIE TE				
Static Water Level (WL): 9.19	1 m								
Total Well Depth (TD): 1549				law e			Hills In		
WL & TD Measuring pt.: TWC			M HILL				3.		
Sat. Screen Volume(gal): [.141				1 - 1			media fina		
Start Purge (hrs): 0855				ve Edition	102		74-7-107		
End Purge (hrs): 0940		JE - DAN	IEVENAIN		型水丛市		15 TEL		
Total Purge Time (min): 45	1 100 110 2	- 199	is a first of	1 1 10 W					
Total Vol. Purged (gal): 23.0	50 LIS						Service Services		
SAMPLE COLLECTION INFORMATION:		O Pey 19				JEST WENT TO SE			
Analysis		Preser	nuotivo		Contologo	D			
/OCs			/ HCL	0 40 1		Requirements		Collected	
				3 - 40 ml v	rials			(Yes) No	
EDB				2 - 40 ml v		Yillaxd (Yes No	
/PH			/ HCL	2 - 40 ml v				Yes / No	
EPH			/ HCL		mber botles			(Yes)/No	
SVOCs PCBs/Pesticides		City of City o	°C		mber botles			(eg/No	
Explosives (Including Nitroglycerine)	10 mm = 10 mm		s*C		mber botles			(es No	
Perchlorate			°C		mber botles			(Yes No	
Metals			HNO ₃		HDPE bottle			Ces / No	
OBSERVATIONS / NOTES:				1 -600 (111	TIOT E DOUIS	2300		(Yes/)No	
Weather: clandy, 30's									
/isual evidence of sheen on purge water - Ye	s or No If ve	s describ	e.						
Olfactory evidence of odor - Yes or No		_,							
Air Supply: Compressed Gas (Nitrogen) or Con									
Comments:									
Circle if Applicables		ililies so							
Circle if Applicable: MS/MSD Duplicate II) No :		(<u>1 1 1 1 1 1 1 1 1 1 </u>		Signature				
Duplicate II					1	~ /J			
	Dupol-	120513			0	~ /0	2		

TŁ	TETRA TE	CH, INC.				PURGE	DATA SH	EET - "LO	OW STRE	SS" GRO	UNDW	ATER	
	e: <u>Former NA</u> D: <u>QRYD9-0</u>		Area Remedial	Investigation		Tetra Tech NUS Charge No. CTO 09/112G00645 Page of OC: DOPO! (If applicable)							
Depth Sa Sample [mpled: كان	0.5 ft bgs 2 / 05 /2013	Screen Int.	Depth 6-13	_ ft bgs	Field Instrum Sample Ana 1. VOCs 2. E 8. Perchlorat	lyses: DB 3. VPH						
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond.	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Со	mments	
0855	9.32	CPM 5/2015I	400	Initiate purge; c	heck drawdo	wn; adjust flow	rate				Paren in		
0900	9.30	80. 10	270	Fill flow-through	cell / monito	or parameter rea	adings						
0910	9.29		60 40		9.69	0,053	5,37	249,6	4.72	48.0		clary	
0920	9.29			21.5	9.85	0.059	5.41	252.3	4.28	20.3	Clear	1 colorless	
0930	9.29				9.42	0.057	5.40	252.3	4.42	11.4	4	lt.	
0935	9.29				9.91	0.056	5.40	253.7	4.40	7.03			
0940	9.29	V	Ý	23.0	9.93	0.057	5.41	253.3	4.47	4.70		4	
	Reached	Stabilization,	Collect Simple	<u> </u>		 							
		5 m 40 24											
	Criteria: <0.3 ft (c				+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10%	+/- 10%	>10 NTUs			

Tt Form 0009 (modified for CTO-69)

Saturated Screen Volume (gallons) 1.141 _ (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



Site Location:

Project No.:

SAMPLING DATA: Date: 12/3/13

PURGE DATA: Date:

0950

Method: Low stress (low-flow)

12/3/13

Method: Low stress (low-flow) Pump Type: Bladder or Peristaltic

Monitor Reading (ppm): 0.0 Well Casing Diameter/Material: 2in)4in, or 6-in (ID) / PVC or steel Screen Interval (ft bgs): 9-14 Static Water Level (WL): 12.48 Total Well Depth (TD): 6.17 WL & TD Measuring pt.: TPVC Sat. Screen Volume(gal): 0.815

Start Purge (hrs): 0835

Total Purge Time (min): 60 Total Vol. Purged (gal): モス. ひ

End Purge (hrs):

VOCs

EDB

VPH

EPH

SVOCs

Perchlorate

Comments:

Circle if Applicable:

MS/MSD

Metals

PCBs/Pesticides

Sample Tubing / Intake Depth: 213.25 55

0945

SAMPLE COLLECTION INFORMATION:

Explosives (Including Nitroglycerine)

cloudy, 30s

Olfactory evidence of odor - Yes or No If yes, describe: Air Supply: Compressed Gas (Nitrogen) of Compressed Air

Duplicate ID No.:

OBSERVATIONS / NOTES:

Analysis

Time:

Project Site Name:

[] Domestic Well Data

[] Other Well Type:

[] QA Sample Type:

[X] Monitoring Well Data

Tetra Tech, Inc.

Brunswick, Maine

Color

(Visual)

Volume

clear

Temp

(°C)

8.10

Temp

GROUNDWATER SAMPLE LOG SHEET

Page i of 1 Former NASB - Quarry Area RI Sample ID No.: QRYD9-GW10-1213 Sample Location: MW- URY-10 B. Geringer OTO 69 / 112000045 Sampled By: CTO NEO9 / 112622063 C.O.C. No.: Type of Sample: [X] Low / Moderate Concentration [] High Concentration DO pΗ **ORP Turbidity** Other (mg/L) (S.U.) (mv) (NTU) 160.8 0.096 1.27 6.42 9.7 S.C. DO ORP **Turbidity** Other **Container Requirements** Preservative Collected 6°C / HCL Yesy No 3 - 40 ml vials (es) No 6°C / HCL 2 - 40 ml vials 6°C / HCL 2 - 40 ml vials Yes / No 6°C / HCL 2 - 1 liter amber botles Yes / No 6°C 2 - 1 liter amber botles Yes No 6°C 2 - 1 liter amber botles Yes/ No 6°C 2 - 1 liter amber botles Yes / No 6°C 1 - 125 ml HDPE bottle 250ml) Yes / No 6°C / HNO₃ 1 - 500-ml HDPE bottle 250ml) Yes / No Visual evidence of sheen on purge water - Yes o(No) If yes, describe:

TŁ	TETRA TE	CH, INC.				PURGE DATA SHEET - "LOW STRESS" GROUNDWATER							
Site Name Sample II	e: <u>Former NA</u> D: <u>GRYD9</u>	SB - Quarry /	Area Remedia 3	l Investigation		Tetra Tech N	US Charge	CTO WEO No. CTO 6	n 112602003 0 1120000	45	Page of licable)		
Depth Sa	mpled: * ate & Time:12	13.25 ft bgs 1 / <u>03</u> /2013 _		orBladder Pump. Depth 9-14 Dup		Field Instrum Sample Ana 1. VOCs 2. E 8. Perchlorate	lyses: DB 3. VPH				er details) es 7. Explosives		
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond.	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Comments		
0835	12.42	CPM4 40PSI		Initiate purge; cl		wn; adjust flow				•			
0840	12.52	1. 11	4x 2c	Fill flow-through	cell / monito	r parameter rea	dings				4924		
0850	12.71				8,21	0.099	631	165.1	3.02	152	Slightly Turbid		
0900	12,79	V			8.01	0,097	6.30	165.1	2,81	102	3. 41		
0910	12.86	CPM4 50 PSI	90	≈ 1.0	8.16	0,096	6.31	166.0	3.13	48.0	clear/coloriuss		
0920	12.94	N 11	y _e ti		8.13	0.097	6.32	1659	21,92	26.7	33 11		
0930	12.94				8.08	0.096	6.40	162.7	1.25	20.0			
0935	12.94				8,06	0.096	6.41	161.3	1.19	17.6			
0940	12.94				8,09	0,096	6.42	160,2	1.23	12.9			
0945	12.94	Ÿ	Ý	≈ 2.0	8.10	0.096	6.42	160.8	1.27	9.7	· ·		
	Reached	Stubilizatu	tollect Sin	niple									
Accentance (Criteria: <0.3 ft (c	drawdown)			+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10%	+/- 10%	>10 NTUs			

Tt Form 0009 (modified for CTO 69)

WEDA

Saturated Screen Volume (gallons) 0.85 (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Page i of !

Project Site Name: Former NASB - Quarry Area RI Sample ID No.: QRY 09-GW11-1213 Site Location: MW- GRY-11 Brunswick, Maine Sample Location: Project No.: OTO 09 / 112G00045 Sampled By: B. Geringer □ Domestic Well Data CTO WED9 | 112602063 C.O.C. No.: [X] Monitoring Well Data Type of Sample: [] Other Well Type: [X] Low / Moderate Concentration [] QA Sample Type: [] High Concentration SAMPLING DATA: S.C. Date: 12/03/13 DO Color Temp ORP **Turbidity** pH Other Time: 1400 (Visual) (°C) (mg/L) (S.U.) (NTU) (mv) Method: Low stress (low-flow) Clear 88.8 0.065 3.14 5.90 294.0 0.19 PURGE DATA: Volume Date: 12/3/13 S.C. DO Temp ORP pН **Turbidity** Other Method: Low stress (low-flow) Pump Type: Bladder or Peristaltic Sample Tubing / Intake Depth: 空中15 b45 Monitor Reading (ppm): 0.0 Well Casing Diameter/Material: 2in, 4in, or 6-in (ID) / PVC or steel Screen Interval (ft bgs): 5.5-10,5 Static Water Level (WL): 9.77 Total Well Depth (TD): 12,70 WL & TD Measuring pt.: TPVC Sat. Screen Volume(gal): 0, 815 Start Purge (hrs): 1305 End Purge (hrs): 1355 Total Purge Time (min): 50 Total Vol. Purged (gal): 21.7 SAMPLE COLLECTION INFORMATION: **Analysis Preservative Container Requirements** Collected 6°C / HCL **VOCs** 3 - 40 ml vials (Yes)/No 6°C / HCL EDB 2 - 40 ml vials Yes / No VPH 6°C / HCL 2 - 40 ml vials Yes / No 6°C / HCL **EPH** 2 - 1 liter amber botles (Yes) No 6°C **SVOCs** 2 - 1 liter amber botles Yes No 6°C PCBs/Pesticides 2 - 1 liter amber botles Yes No Explosives (Including Nitroglycerine) 6°C 2 - 1 liter amber botles Yes/ No 6°C Perchlorate 250 MI 1 - 125-ml-HDPE bottle Yes / No Metals 6°C/HNO₃ 1 -500 mLHDPE bottle 250 ml Yes) No **OBSERVATIONS / NOTES:** Weather: Mostly cloudy Low 40's Visual evidence of sheen on purge water - Yes o(No) If yes, describe: Olfactory evidence of odor - Yes of No If yes, describe: Air Supply: Compressed Gas (Nitrogen) or Compressed Air Comments: Circle if Applicable: Signature(s): MS/MSD **Duplicate ID No.:** B: g=

TŁ	TETRA TE	CH, INC.				PURGE	DATA SH	EET - "LO	OW STRE	SS" GRO	UNDW	ATER
Site Name Sample ID	e: <u>Former NA</u>): <u>QRY 09- (</u>	SB - Quarry A	Area Remedia	I Investigation		Tetra Tech N	US Charge	No. CTO G	7 11260200 0 1126006		Page <u>l</u> licable)	of <u>/</u>
Depth Sar Sample D	npled: જુલ	.75 ft bgs 2 / <u>03</u> /2013 _	Screen Int.	of Bladder Pump Depth 5.5 - 10.	ft bgs	Field Instrume Sample Anal 1. VOCs 2. E 8. Perchlorate	yses: DB 3. VPH					
Clock Time 24hr	Water Depth below MP ft	Pump Dial 1	Purge Rate ml/min	Cum. Volume Purged Gals.	Temp °C	Spec. Cond. · uS/cm ·M5/cm	pH (S.U.)	ORP/Eh3 mv	DO mg/L	Turbidity NTU	Con	nments
1305	9.81	CPM 4 30 PSF	120	Initiate purge; cl	neck drawdov	vn; adjust flow	rate					= 31 = 31 = 30 loss.
1310	9.81	65 14	10 11	Fill flow-through	cell / monitor	r parameter rea	dings					
1315	9.81				8.87	0.066	5.97	187.1	4,34	11.6	Clear	colucuss
1325	9.81	Eu	150	20,5	8.82	0.066	5.93	204,9	3,70	5.61	11	
1335	9.81				8.86	0.066	5.91	214.6	3,44	1.87		
1340	9.81				8.85	0,066	5.91	217.7	3,37	0.87		
1345	9.81				8.88	0.066	5,90	220.4	3,00	0.41		25.25
1350	9.81				8.83	0.066	5.90	222,1	3.10	0.33		
1355	9.81	V .	V	21.7	8.88	0.065	5,98	224,0	3.14	0.19	V	/
	Reach	Shbilization,	collect Simp	le								
			592-175-17-17-17-17-17-17-17-17-17-17-17-17-17-		<u></u>							
	,											
AND COLUMN TO THE STATE OF THE											7	
Acceptance C	riteria: <0.3 ft (d	drawdown)		12.73/2	+/- 10%	+/- 10%	+/- 0.2 S.U.	+/- 10%	+/- 10%	>10 NTUs		

Tt Form 0009 (modified for CTO 99)

WEDG

Saturated Screen Volume (gallons) 0.815 _ (2" screen = 0.163 gals./ft of depth; 4" =0.653 gals/ft; 6"=1.469gals/ft)

Pump dial setting (for example: hertz, cycle/min, etc.)
 microSiemens per cm (same as micromhos/cm) at 25 °C.
 Oxidation reduction potential (stand in for Eh).



GROUNDWATER SAMPLE LOG SHEET

Site Location: Project No.: [] Domestic Well Data [X] Monitoring Well Data [] Other Well Type: [] QA Sample Type:	Brunswick, CTO 60/1 CTO 60/1	12G00645			Samo	le Location:	MW ~) RU _ 17	
[X] Monitoring Well Data [] Other Well Type:	CTO HEOQ	11126021		EW_F V		led By:	IN IN	WKY-IL	
[] Other Well Type:			063			C. No.:			
			100			of Sample:			
[] GA Sample Type:			[X] Low / Moderate Concentration						
The second secon			Series Series		_ [] Н	igh Concentr	ation		
AMPLING DATA:		Tree Sales	Liste N.F.						
Date: /2/5//3	Color	Temp	s.c.	DO	pH	ORP	Turbidity	Other	
Time: NZZ	(Visual)	(°C)	MS Cim	(mg/L)	(S.U.)	(mv)	(NTU)		
Method: Low stress (low-flow)	Cliar	44	#5	1334	640	1233	1		
URGE DATA:		9.89	1415	1250	60.00	127.6	6.40		
Pate: /2/C//3 Method: Low stress (low-flow)	Volume	Temp	S.C.	DO	pН	ORP	Turbidity	Other	
Pump Type Bladder or Peristaltic	+ >	k -							
	11125	1							
Sample Tubing / Intake Depth:	14.75		1		VIII (Alle)				
Monitor Reading (ppm):	0.0		1						
Well Casing Diameter/Material:				1	100				
tip 4in, or 6-in (ID) / PVC or steel	101		The second	1					
Screen Interval (ft bgs):	101	ar Same (Sa			0				
Static Water Level (WL):	2.81				1	,	1, 15-		
Total Well Depth (TD):	19.75				1	-6			
VL & TD Measuring pt.:	1330					FOW	^		
sat. Screen Volume(gal):	2,20						-10.		
Start Purge (hrs):	922						-	ΔL	
and Purge (hrs):	1015							reex	
Total Purge Time (min):	53	A MARK	1 5/					/	
otal Vol. Purged (gal):	5.0	TVP.							
AMPLE COLLECTION INFORMATION:									
Analysis		Presei	rvative		Container	Requirements		Collected	
/OCs		6°C	/ HCL	3 - 40 ml v	rials			Yes/No	
DB 1		6°C	/ HCL	2 - 40 ml v	rials			CYPs/No	
PH 2012 A STATE OF THE STATE OF		6°C	/ HCL	2 - 40 ml v	rials	A STATE OF THE REAL PROPERTY.		Yes / No	
PH			/ HCL		mber botle		in distance	Yes No	
SVOCs			s*C		mber botle		fi. A state	(Yes)No	
CBs/Pesticides explosives (Including Nitroglycerine)			5°C	2 - 1 liter a				Yes / No	
Perchlorate			5°C	2 - 1 liter a	HDPE bott		owl.	Ves No	
Metals			HNO ₃	THE RESERVE TO SERVE	HDPE bott		3	Yes No	
		-	0 54500	UNIVERSE S	as manufacture		77-6	Que INC	

Tt	TETRATECH
It	I WILLIAM I WOLL

LOW FLOW PURGE DATA SHEET

PAGE 2 OF 2

PROJECT SITE NAME:

NAS Brunswick / Quarry

WELL ID.:

MW-QRY-12

PROJECT NUMBER:

CTO 069 / WE09 (112G00645/112G02063)

DATE:

12/5/13

Time	Water Level	Pump Setting(s) ¹	Flow	рН	Sp. Cond.	Temp.	Turb.	DO	ORP	Comments
(Hrs.)	(ft. below TOC)		(mĽ/Min.)	(S.U.)	(mS/cm)	(Celsius)	(NTU)	(mg/L)	mV	
922	2,80	25 psi	432	Start / Initial	Commence of the Commence of th					
925	2,85	25	485	6.71	,411	9,72	20,40	1450	143,70	CRAT
135	2,85	25	485	6.69	1412	9,125	14.60	1350	139120	clear
145	2,86	25	485	to.1.65	,413	9.78	1/180	1290	133,0	cear
155	2.85	25	485	6.40	1414	9,78	9.78	1280	130.30	Clear
1005	2,85	24	485	6.60	.415	9,89	8.35	1250	127,0	ckar
1015	2.85	25	455	10,40	1415	9,89	6.40	,250	127.6	chal
										7 2 2
10 1				em valle in						
									1	
Filbraj, iu										
S1										
			W	The Value of	Present a					
						The wester				

¹ Pump Setting(s) refers to dial settings (cycles/min, psi, etc.)

Pump Intake Depth: 14.75

ft TPVC

Sat. Well Volume:

2.20

 $(2 in = 0.163 gal/ft H_20)$

Total Volume Purged: gal / L

SLUG TEST FIELD FORMS AND CALCULATIONS A-5

TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

WATER TABLE

Н

Project:

Quarry

NAS Brunswick, ME

Well Number

Toet Type

Test Type Test Date MW-QRY-01B

Falling Head Calcs By: TSE 12/3/2013 Checked By: SJC

 $2r_c$

 $2r_w$

Well/Aquifer Information Well Casing Diameter (2)

Well Casing Diameter
$$(2r_c)$$
 = 2.0 in Use r_c or r_c * rc r_c = 0.083 feet

Effective Screen Length
$$(L_e)$$
 = 10.00 feet

$$L_e/r_w = 60.0$$

Intermediate Calculations

For Lw < H

$$\ln \frac{R_{E}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln(H - L_{w})/r_{w}}{L_{E}/r_{w}} \right]^{1}$$

In (R_e/r_w) = Use formula for Lw=H

Values from time-drawdown graph

$y_0 =$	1.34	feet
y _t =	0.06	feet
t=	8.0	sec

Dimensionless Parameters as Function of La/ru

(See page 2 for calcs)

For L_w_H

$$\frac{1}{\ln \frac{R_e}{r_w}} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 3.28$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 2.65E-02 \text{ feet / minute}$$

$$K = 3.82E+01 \text{ feet / day}$$

$$K = 1.35E-02 \text{ centimeters / second}$$



Project:

Quarry

NAS Brunswick, ME

Well Number

MW-QRY-01B

Test Type Test Date Falling Head 12/3/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= $r_w =$ 10.00 feet

0.167 feet

from page 1

L/r_w=

60.0

log L/r_w=

1.778

Bouwer and Rice Coefficients

A=

3.5

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

0.5

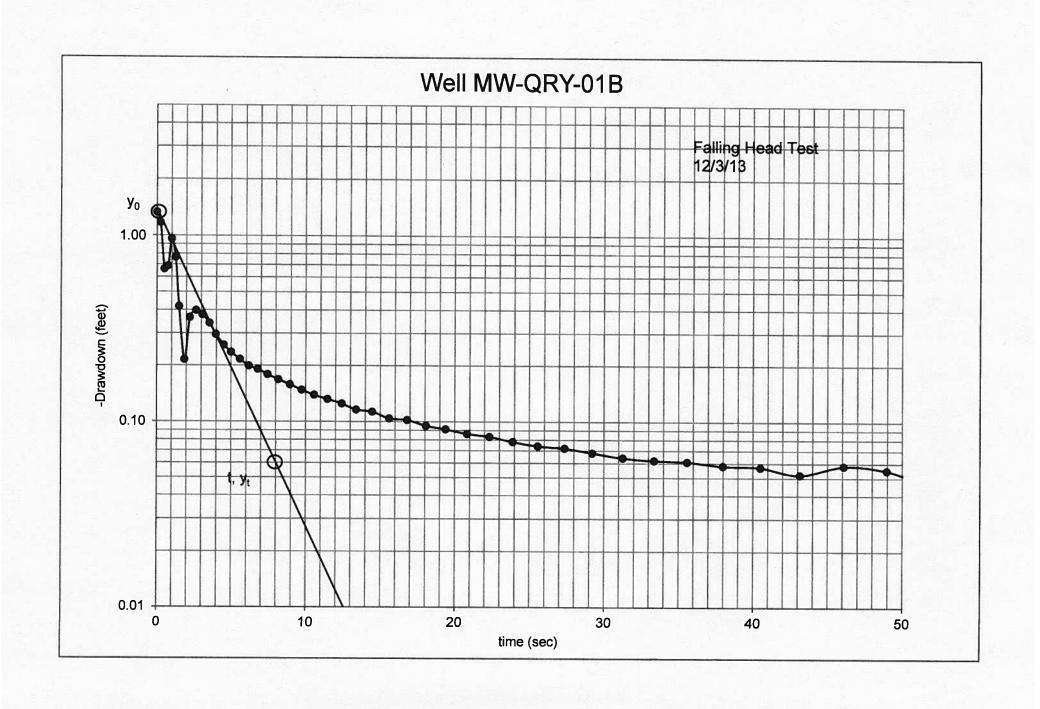
 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

3.2

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$

 $x = log L/r_w$



MW-QRY-01B Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet	
12/3/2013 11:20:00	0	4.768	9.519	-0.026			
12/3/2013 11:20:00	0.25	4.768					
12/3/2013 11:20:00	0.5	4.767					
12/3/2013 11:20:00	0.75	4.766	9.564	-0.022			
12/3/2013 11:20:01		4.767	9.57				
12/3/2013 11:20:01	1.25	4.767	9.577				
12/3/2013 11:20:01	1.5	4.767	9.581				
12/3/2013 11:20:01	1.75	4.772					
12/3/2013 11:20:02	2	4.823	9.588				
12/3/2013 11:20:02	2.25	4.915	9.592	-0.365			
12/3/2013 11:20:02	2.5	4.985	9.593	-0.528			
12/3/2013 11:20:02	2.75	5.018	9.598				
12/3/2013 11:20:03	3	5.105	9.597	-0.805			
12/3/2013 11:20:03	3.25	5.205	9.599				
12/3/2013 11:20:03	3.5	5.1	9.602	-0.793			
12/3/2013 11:20:03	3.75	5.173	9.603	-0.96			
12/3/2013 11:20:04							
12/3/2013 11:20:04	4.25	5.307	9.604				
12/3/2013 11:20:04	4.5	5.335				0	1.335 <
12/3/2013 11:20:04					0.29		1.171
12/3/2013 11:20:05							0.661
12/3/2013 11:20:05							0.686
12/3/2013 11:20:05			9.611				0.956
12/3/2013 11:20:05							0.764
12/3/2013 11:20:06							0.417
12/3/2013 11:20:06	6.36						0.215
12/3/2013 11:20:06							0.364
12/3/2013 11:20:07	7.14	4.929	9.594				0.397
12/3/2013 11:20:07							0.377
12/3/2013 11:20:08							0.340
12/3/2013 11:20:08	8.46	4.885					0.295
12/3/2013 11:20:09	9	4.868	9.58				0.258
12/3/2013 11:20:09	9.48	4.859	9.582				0.236
12/3/2013 11:20:10	10.08	4.85	9.574	-0.216	5.58		0.216
12/3/2013 11:20:10	10.68	4.843	9.576	-0.199	6.18		0.199

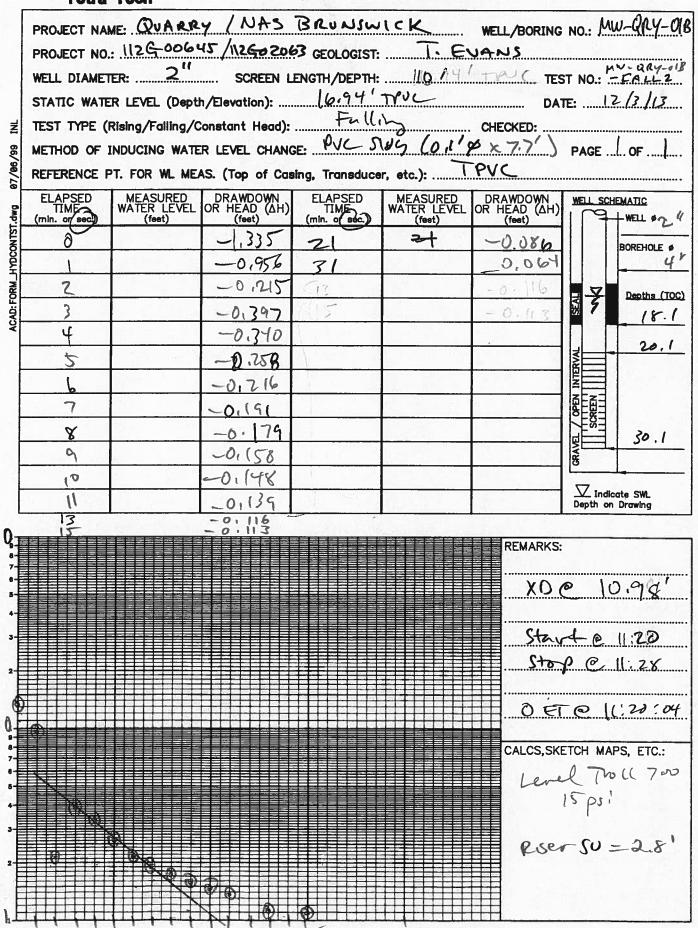
MW-QRY-01B Falling Head Test

Falling Head Test	Elapsed Time	SN#: 164036	SN#: 164036	SN#: 164036	Elapsed Time (Corr)	-Drawdown
Date and Time	Seconds	Pressure (PSI)	Temperature (C)	Level Depth To Water (ft)	seconds	feet
12/3/2013 11:20:11	11.28	4.84	9.571	-0.191	6.78	0.19
12/3/2013 11:20:12	11.94	4.834	9.572			
12/3/2013 11:20:12	12.66	4.829	9.569			
12/3/2013 11:20:13	13.44	4.825	9.566			
12/3/2013 11:20:14	14.22	4.821	9.566	-0.148	9.72	
12/3/2013 11:20:15	15.06	4.817	9.564	-0.139	10.56	
12/3/2013 11:20:16	15.96	4.814	9.564	-0.132	11.46	
12/3/2013 11:20:16	16.92	4.811	9.561	-0.125	12.42	0.12
12/3/2013 11:20:17	17.88	4.807	9.562	-0.116	13.38	0.11
12/3/2013 11:20:19	18.96	4.806	9.56	-0.113	14.46	0.11
12/3/2013 11:20:20	20.1	4.802	9.56	-0.104	15.60	0.10
12/3/2013 11:20:21	21.3	4.801	9.56	-0.102	16.80	0.10
12/3/2013 11:20:22	22.56	4.798	9.558	-0.095	18.06	0.09
12/3/2013 11:20:23	23.88	4.796	9.557	-0.091	19.38	0.09
12/3/2013 11:20:25	25.32	4.794	9.556	-0.086	20.82	
12/3/2013 11:20:26	26.82	4.793	9.556	-0.083	22.32	0.08
12/3/2013 11:20:28	28.38	4.79	9.554	-0.078	23.88	0.07
12/3/2013 11:20:30	30.06	4.789	9.557	-0.074	25.56	0.07
12/3/2013 11:20:31	31.86	4.788	9.553	-0.072	27.36	0.07
12/3/2013 11:20:33	33.72	4.786	9.555	-0.068	29.22	0.06
12/3/2013 11:20:35	35.76	4.785	9.551	-0.064	31.26	0.06
12/3/2013 11:20:37	37.86	4.784	9.553	-0.062	33.36	0.06
12/3/2013 11:20:40	40.08	4.783	9.552	-0.061	35.58	0.06
12/3/2013 11:20:42	42.48	4.782	9.551	-0.058	37.98	0.05
12/3/2013 11:20:45	45	4.782	9.548	-0.057	40.50	0.05
12/3/2013 11:20:47		4.78	9.547	-0.052	43.14	0.05
12/3/2013 11:20:50	50.577	4.782	9.546	-0.058	46.08	0.05
12/3/2013 11:20:53	53.46	4.781	9.546	-0.055	48.96	0.05
12/3/2013 11:20:56	56.64	4.777	9.546	-0.046	52.14	0.04
12/3/2013 11:21:00	60	4.777	9.545	-0.046	55.50	0.04
12/3/2013 11:21:03	63.6	4.776	9.545	-0.044	59.10	0.04
12/3/2013 11:21:07	67.2	4.776	9.546	-0.044	62.70	0.04
12/3/2013 11:21:11	71.4				66.90	0.04
12/3/2013 11:21:15					71.10	
12/3/2013 11:21:19					75.30	

MW-QRY-01B Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet
12/3/2013 11:21:24	84.6	4.774	9.544	-0.039	80.10	0.039
12/3/2013 11:21:30	90					
12/3/2013 11:21:34	94.8	4.773				
12/3/2013 11:21:40	100.8	4.772				
12/3/2013 11:21:46	106.8	4.772	9.543			
12/3/2013 11:21:52	112.8	4.771	9.543			
12/3/2013 11:21:59	119.399	4.771	9.538			
12/3/2013 11:22:06	126.6	4.77				
12/3/2013 11:22:14	134.399	4.77				
12/3/2013 11:22:22	142.2	4.77				
12/3/2013 11:22:30	150.6	4.769				
12/3/2013 11:22:39	159.6	4.769				
12/3/2013 11:22:49	169.2	4.769	9.536			
12/3/2013 11:22:58	178.8	4.769	9.533	-0.028		
12/3/2013 11:23:09	189.6	4.769	9.537			
12/3/2013 11:23:21	201	4.77	9.535	-0.029		
12/3/2013 11:23:33	213	4.769	9.537			
12/3/2013 11:23:45	225.599	4.769	9.533	-0.027	221.10	
12/3/2013 11:23:58	238.8	4.768	9.534	-0.027		
12/3/2013 11:24:13	253.2	4.769	9.531	-0.027		
12/3/2013 11:24:28	268.2	4.769	9.53	-0.028	263.70	0.028
12/3/2013 11:24:43	283.799	4.769	9.531	-0.028	279.30	
12/3/2013 11:25:00	300.599	4.768	9.531	-0.027	296.10	0.027
12/3/2013 11:25:18	318.6	4.769	9.528	-0.027	314.10	0.027
12/3/2013 11:25:37	337.2	4.768	9.529	-0.026	332.70	0.026
12/3/2013 11:25:57	357.6	4.768	9.529	-0.026	353.10	0.026
12/3/2013 11:26:18	378.6	4.769	9.527	-0.028	374.10	0.028
12/3/2013 11:26:40	400.799	4.768	9.53	-0.026	396.30	0.026
12/3/2013 11:27:04	424.799	4.769	9.527	-0.027	420.30	0.027
12/3/2013 11:27:30	450	4.768	9.526	-0.025	445.50	0.025
12/3/2013 11:27:56	476.399	4.767	9.523	-0.023	471.90	0.023
12/3/2013 11:28:24	504.6	4.767	9.523	-0.023	500.10	





1 1 (01)

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

Well Number

Test Type Test Date

MW-QRY-01B

Calcs By: TSE Rising Head 12/3/2013 **Checked By: SJC**

Well/Aguifer Information

Well/Aquilet illioilliation		
Well Casing Diameter (2r _c) =	2.0	in
Use r _c or r _c *	rc	
$r_c =$	0.083	feet
Borehole Diameter (2r _w) =	4.0	in
r _w =	0.167	feet
Screen Length (b) =	10.0	feet
Water Level at Start of Test=	16.92	feet TPVC
Total Well Depth =	30.1	feet TPVC
Effective Screen Length (L _e) =	10.00	feet
L _w =	13.18	feet
Bottom of Aquifer =	27.44	feet bgs
(Ground Surface Elevation =	110.37	feet MSL)
(TPVC Elevation =	113.03	feet MSL)
` H=	13.18	feet

Values from time-drawdown graph

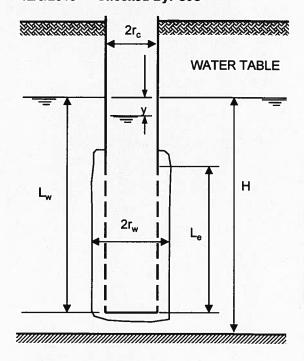
y ₀ =	1.61	feet
y _t =	0.05	feet
t =	6.0	sec

Dimensionless Parameters as Function of La/rw

 $L_e/r_w =$

60.0

(See page 2 for calcs)



Intermediate Calculations

For Lw < H

$$\ln \frac{R_{e}}{r_{w}} = \frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}}$$

In (R_e/r_w) = Use formula for Lw=H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 3.28$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 3.96\text{E-02 feet / minute}$$

$$K = 5.70\text{E+01 feet / day}$$

$$K = 2.01\text{E-02 centimeters / second}$$

Notes



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-01B

Test Type Test Date

Rising Head 12/3/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= $r_w =$

10.00 feet 0.167 feet

from page 1

L/r_w=

60.0

log L/r_w=

1.778

Bouwer and Rice Coefficients

A=

3.47

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

0.53

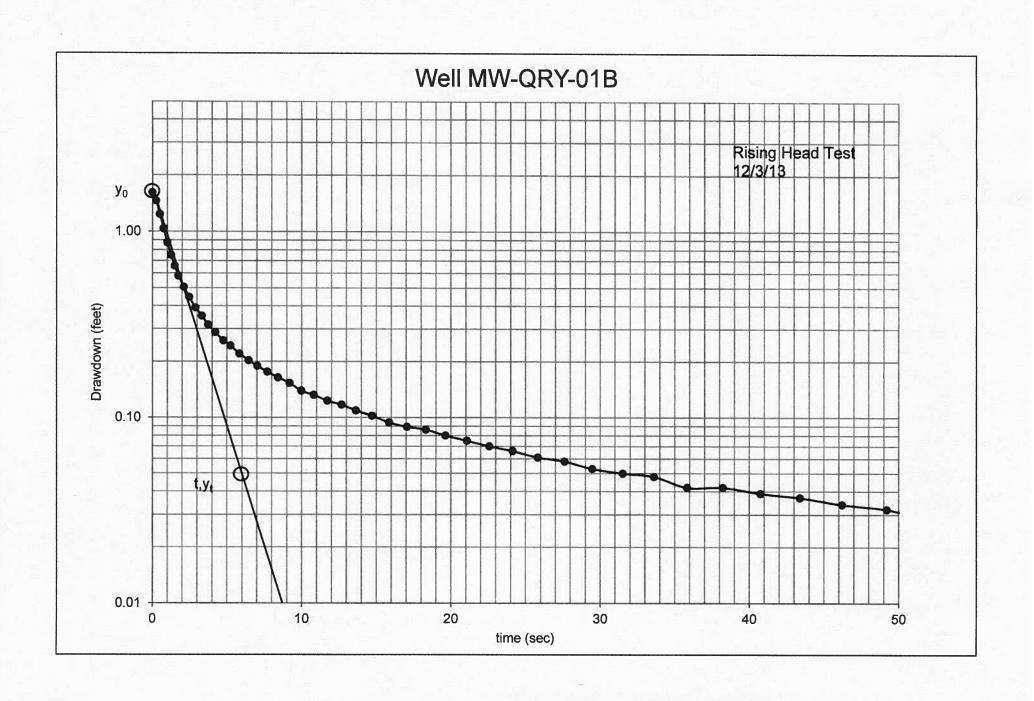
 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

3.18

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$

 $x = \log L/r_w$



MW-QRY-01B Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet	
12/3/2013 11:36		4.77	9.51	-0.016			
12/3/2013 11:36	0.251	4.769	9.533	-0.014			
12/3/2013 11:36	0.501	4.768	9.546	-0.012			
12/3/2013 11:36	0.751	4.769	9.554	-0.014			
12/3/2013 11:36	1.001	4.769	9.563	-0.014			
12/3/2013 11:36	1.251	4.767	9.568	-0.01		- AT-	
12/3/2013 11:36	1.501	4.769	9.571	-0.013			
12/3/2013 11:36	1.751	4.768	9.577	-0.012			
12/3/2013 11:36	2.001	4.768	9.58	-0.013			
12/3/2013 11:36	2.251	4.768	9.582	-0.011			
12/3/2013 11:36	2.501	4.59	9.589	0.399			
12/3/2013 11:36	2.751	4.205	9.588	1.289			
12/3/2013 11:36	3.001	4.311	9.59	1.045			
12/3/2013 11:36	3.251	4.505	9.592	0.596			
12/3/2013 11:36	3.501	4.382	9.595	0.879			
12/3/2013 11:36	3.751	4.279	9.597	1.117			
12/3/2013 11:36	4.001	4.127	9.595	1.468			
12/3/2013 11:36	4.251	4.066	9.599	1.609	0.00)	1.609 < h
12/3/2013 11:36	4.501	4.133	9.6	1.454	0.25	5	1.454
12/3/2013 11:36	4.751	4.23	9.603	1.231	0.50)	1.231
12/3/2013 11:36	5.001	4.315	9.603	1.034	0.75	5	1.034
12/3/2013 11:36	5.251	4.385	9.603	0.873	1.00)	0.873
12/3/2013 11:36	5.501	4.438	9.606	0.751	1.25	5	0.751
12/3/2013 11:36	5.751	4.479	9.604	0.656	1.50		0.656
12/3/2013 11:36	6.001	4.512	9.605	0.58	1.75	5	0.580
12/3/2013 11:36	6.361	4.544	9.598	0.505	2.1		0.505
12/3/2013 11:36	6.721	4.57	9.592	0.445	2.47	7	0.445
12/3/2013 11:36	7.141	4.594	9.585	0.39	2.89	9	0.390
12/3/2013 11:36	7.561	4.611	9.582	0.352			0.352
12/3/2013 11:36	7.981			0.315			0.315
12/3/2013 11:36	8.461	4.639	9.579	0.287	4.21		0.287
12/3/2013 11:36					4.75		0.259
12/3/2013 11:36					5.23		0.243
12/3/2013 11:36					5.83		0.220
12/3/2013 11:36	10.692	4.675	9.566	0.203	6.44	List Institute	0.203

MW-QRY-01B Rising Head Test

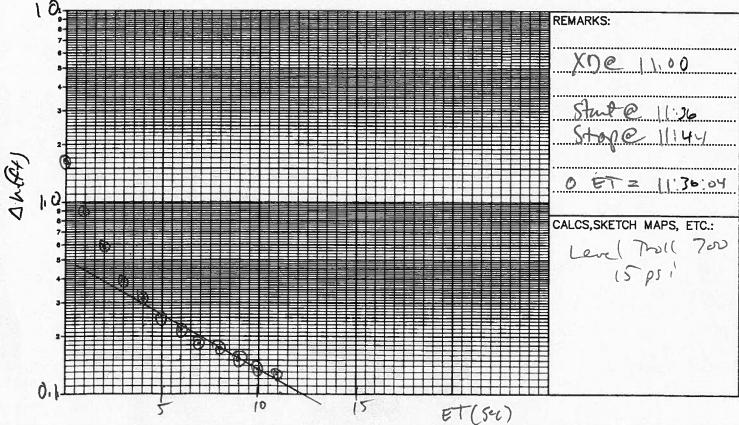
Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/3/2013 11:36	11.28	4.681	9.569	0.189	7.03	0.18
12/3/2013 11:36	11.94	4.687	9.564	0.176		
12/3/2013 11:36	12.66	4.692	9.565	0.164	8.41	
12/3/2013 11:36	13.44	4.697	9.561	0.153		
12/3/2013 11:36	14.22	4.703	9.559	0.139	9.97	
12/3/2013 11:36	15.06	4.706	9.559	0.132	10.81	0.13
12/3/2013 11:36	15.96	4.71	9.559	0.123	11.71	
12/3/2013 11:36	16.92	4.712	9.555	0.117	12.67	0.11
12/3/2013 11:36	17.88	4.716	9.554	0.109	13.63	0.10
12/3/2013 11:36	18.96	4.719	9.554	0.102	14.71	0.10
12/3/2013 11:36	20.101	4.722	9.552	0.094	15.85	0.09
12/3/2013 11:36	21.301	4.724	9.553	0.089	17.05	0.08
12/3/2013 11:36	22.561	4.726	9.551	0.086	18.31	0.08
12/3/2013 11:36	23.88	4.728	9.549	0.08	19.63	0.08
12/3/2013 11:36	25.32	4.731	9.551	0.075	21.07	0.07
12/3/2013 11:36	26.82	4.733	9.548	0.07	22.57	0.07
12/3/2013 11:36	28.38	4.734	9.548	0.066	24.13	0.06
12/3/2013 11:36	30.061	4.737	9.548	0.061	25.81	0.06
12/3/2013 11:36	31.86	4.738	9.547	0.058	27.61	0.05
12/3/2013 11:36	33.72	4.74	9.546	0.053	29.47	0.05
12/3/2013 11:36	35.76	4.741	9.546	0.05	31.51	0.05
12/3/2013 11:36	37.86	4.742	9.545	0.048	33.61	0.04
12/3/2013 11:36	40.08	4.745	9.544	0.042	35.83	0.04
12/3/2013 11:36	42.481	4.745	9.544	0.042	38.23	0.04
12/3/2013 11:36	45	4.746	9.543	0.039	40.75	0.03
12/3/2013 11:36	47.64	4.747	9.541	0.037	43.39	0.03
12/3/2013 11:36	50.46	4.748	9.538	0.034	46.21	0.034
12/3/2013 11:36	53.46	4.749	9.54	0.032	49.21	0.03
12/3/2013 11:36	56.64	4.751	9.537	0.028	52.39	0.02
12/3/2013 11:37	60	4.752	9.538	0.026	55.75	0.020
12/3/2013 11:37	63.6					
12/3/2013 11:37						
12/3/2013 11:37						
12/3/2013 11:37						
12/3/2013 11:37	79.8	4.755	9.53	0.018	75.55	0.018

MW-QRY-01B Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/3/2013 11:37	84.6	4.756	9.532	0.016	80.35	0.016
12/3/2013 11:37	90	4.757	9.532	0.014		
12/3/2013 11:37	94.8	4.757	9.53	0.014		
12/3/2013 11:37	100.8	4.758	9.531	0.011		
12/3/2013 11:37	106.8	4.758	9.528	0.011		
12/3/2013 11:37	112.8	4.759	9.527			
12/3/2013 11:37	119.4	4.759	9.525	0.009		
12/3/2013 11:38	126.6	4.759	9.525	0.01		
12/3/2013 11:38	134.4	4.76	9.523			
12/3/2013 11:38	142.2	4.761	9.523			
12/3/2013 11:38	150.6	4.76	9.523	0.006		
12/3/2013 11:38	159.6	4.761	9.521	0.004	155.35	
12/3/2013 11:38	169.2	4.761	9.519	0.005	164.95	0.005
12/3/2013 11:38	178.8	4.761	9.521	0.005	174.55	0.005
12/3/2013 11:39	189.6	4.762	9.517	0.003	185.35	0.003
12/3/2013 11:39	201	4.762	9.513	0.002	196.75	0.002
12/3/2013 11:39	213	4.763	9.513	0.001	208.75	0.001
12/3/2013 11:39	225.6	4.762	9.514	0.002	221.35	0.002
12/3/2013 11:39	238.8	4.764	9.513	-0.003	234.55	-0.003
12/3/2013 11:40	253.2	4.763	9.512	0.001	248.95	0.001
12/3/2013 11:40	268.2	4.763	9.512	0	263.95	0.000
12/3/2013 11:40	283.8	4.763	9.51	0	279.55	0.000
12/3/2013 11:41	300.6	4.763	9.512	0	296.35	0.000
12/3/2013 11:41	318.6	4.763	9.509	-0.001	314.35	-0.001
12/3/2013 11:41	337.2	4.764	9.509	-0.002	332.95	-0.002
12/3/2013 11:41	357.6	4.764	9.512	-0.002	353.35	-0.002
12/3/2013 11:42	378.6	4.764	9.513	-0.001	374.35	-0.001
12/3/2013 11:42	400.8	4.763	9.514	-0.001	396.55	-0.001
12/3/2013 11:43	424.8	4.764	9.512	-0.002	420.55	-0.002
12/3/2013 11:43	450	4.763	9.513	0.001	445.75	0.001
12/3/2013 11:43	476.4	4.764	9.513	-0.002	472.15	-0.002



	WELL DIAMET	: 112G-006° ER: 2" R LEVEL (Depti	TE	MU-QKY-0 ST NO.: RIS/AG TE: 12/3/13			
	TEST TYPE (I	Rising/Falling/C	constant Head):	R151	NJ.	CHECKED:	, , , , , , , , , , , , , , , , , , , ,
	METHOD OF 1	INDUCING WATE	R LEVEL CHANG	E Slug	101/0×	7:7')	PAGE .1 OF .1
1	REFERENCE F	T. FOR WL ME	AS. (Top of Cas	ing, Transduce	r, etc.):	PVC	
	ELAPSED TIME (min. or sec)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	WELL SCHEMATIC
	0		1,609	13		0,109	BOREHOLE #
	an El III	NELVE TO TAKE	0.873	_ (5		0,102	4
L	2		0.58	21		01075	Depths (TOC
L	3		0.39	25		0.050	Depths (TOC)
	4	Ē.,,	0,315				7 20./
	5	3 1 1 1 1 2 3 6	6.259				RVA
	6		0.223	= - 210			
	7		0,189			lian I	
	8		01176				30.1
	9		0,157				Se S
L	13		0,139				✓ Indicate SWL
	11		0,132				Depth on Drawing



TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

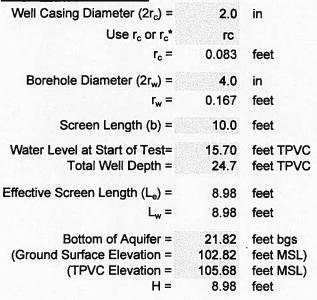
NAS Brunswick, ME

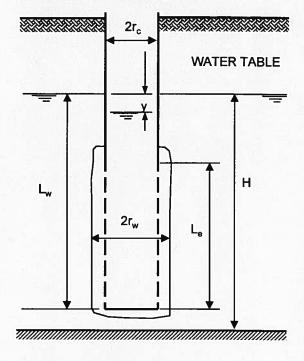
Well Number

MW-QRY-02

Test Type Test Date Rising Head Calcs By: TSE 12/3/2013 Checked By: SJC

Well/Aguifer Information





Values from time-drawdown graph

y ₀ =	1.81	feet
y _t =	0.07	feet
t = 7	9.0	sec

Intermediate Calculations

For L_w < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}} \right]^{1}$$

In (R_e/r_w) = Use formula for Lw=H

Dimensionless Parameters as Function of La/r,

 $L_e/r_w =$

53.9

(See page 2 for calcs)

For L_w= H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 3.03$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 2.54\text{E-}02 \text{ feet / minute}$$

$$K = 3.65\text{E+}01 \text{ feet / day}$$

$$K = 1.29\text{E-}02 \text{ centimeters / second}$$

Notes



Project: Quarry

NAS Brunswick, ME

Well Number

MW-QRY-02

Test Type

Rising Head

Test Date

12/3/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= 8.98 feet 0.167 feet $r_w =$

from page 1

L/r_w= 53.9

log L/r_w= 1.731

Bouwer and Rice Coefficients

A= 3.30 where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

0.49

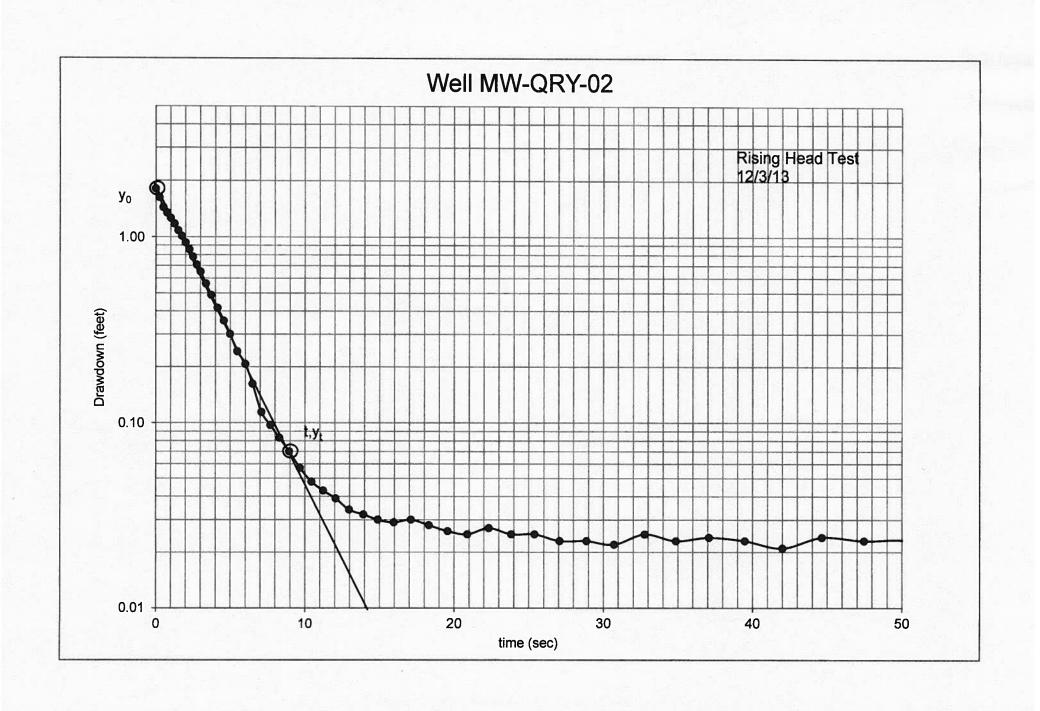
 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

2.93

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$

 $x = \log L/r_w$



MW-QRY-02 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet	
12/3/2013 16:10	0	3.853	9.757	-0.003			
12/3/2013 16:10	0.251	3.854	9.775	-0.005			
12/3/2013 16:10	0.501	3.853	9.789	-0.002			
12/3/2013 16:10	0.751	3.853	9.8	-0.004			
12/3/2013 16:10	1.001	3.854	9.803	-0.006			
12/3/2013 16:10	1.251	3.854	9.811	-0.006			
12/3/2013 16:10	1.501	3.854	9.815	-0.006			
12/3/2013 16:10	1.751	3.854	9.819	-0.005			
12/3/2013 16:10	2.001	3.854	9.822	-0.006			
12/3/2013 16:10	2.251	3.371	9.828	1.11			
12/3/2013 16:10	2.501	3.505	9.827	0.8			
12/3/2013 16:10	2.751	3.439	9.83	0.952			
12/3/2013 16:10	3.001	3.069	9.833	1.807	0.00)	1.807 <
12/3/2013 16:10	3.251	3.149					1.622
12/3/2013 16:10							1.435
12/3/2013 16:10							1.345
12/3/2013 16:10							1.261
12/3/2013 16:10							1.176
12/3/2013 16:10							1.083
12/3/2013 16:10	4.751	3.415	9.844			5	1.009
12/3/2013 16:10	5.001						0.930
12/3/2013 16:10	5.251	3.482	9.846	0.853	2.25	5	0.853
12/3/2013 16:10	5.501	3.514	9.847	0.78	2.50)	0.780
12/3/2013 16:10	5.751	3.545	9.846	0.707	2.75	5	0.707
12/3/2013 16:10	6.001	3.571	9.848	0.649	3.00)	0.649
12/3/2013 16:10	6.36	3.609	9.839	0.561	3.36	3	0.561
12/3/2013 16:10	6.72	3.641	9.836	0.487	3.72	2	0.487
12/3/2013 16:10	7.14	3.672	9.83	0.415	4.14	1	0.415
12/3/2013 16:10	7.56	3.698	9.827	0.354	4.56	3	0.354
12/3/2013 16:10		3.722	9.823	0.3	4.98	3	0.300
12/3/2013 16:10	8.46	3.747	9.82	0.242	5.46	3	0.242
12/3/2013 16:10	9	3.762	9.817	0.207	6.00)	0.207
12/3/2013 16:10	9.48	3.782	9.816	0.162	6.48	3	0.162
12/3/2013 16:10	10.08	3.802	9.811	0.114	7.08	3	0.114
12/3/2013 16:10	10.68	3.81	9.847	0.097	7.68	3	0.097

MW-QRY-02 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/3/2013 16:10	11.28	3.816	9.827	0.083	8.28	0.083
12/3/2013 16:10	11.94	3.821	9.816	0.07		
12/3/2013 16:10	12.66	3.827	9.808	0.057		
12/3/2013 16:10	13.44	3.831	9.804	0.048	10.44	
12/3/2013 16:10	14.22	3.833	9.805	0.043	11.22	0.043
12/3/2013 16:10	15.06	3.835	9.804	0.039	12.06	0.039
12/3/2013 16:10	15.96	3.837	9.799	0.034	12.96	
12/3/2013 16:10	16.92	3.838	9.799	0.032	13.92	0.032
12/3/2013 16:10	17.88	3.839	9.796	0.03	14.88	0.030
12/3/2013 16:10	18.96	3.839	9.8	0.029	15.96	0.029
12/3/2013 16:10	20.1	3.839	9.794	0.03	17.10	0.030
12/3/2013 16:10	21.3	3.84	9.791	0.028	18.30	0.028
12/3/2013 16:10	22.56	3.84	9.794	0.026	19.56	0.026
12/3/2013 16:10	23.88	3.841	9.79	0.025	20.88	0.025
12/3/2013 16:10	25.32	3.84	9.79	0.027	22.32	0.027
12/3/2013 16:10	26.82	3.841	9.792	0.025	23.82	0.025
12/3/2013 16:10	28.38	3.841	9.789	0.025	25.38	0.025
12/3/2013 16:10	30.06	3.842	9.79	0.023	27.06	0.023
12/3/2013 16:10	31.86	3.842	9.789	0.023	28.86	0.023
12/3/2013 16:10	33.72	3.842	9.782	0.022	30.72	0.022
12/3/2013 16:10	35.76	3.841	9.785	0.025	32.76	0.025
12/3/2013 16:10	37.86	3.842	9.786	0.023	34.86	0.023
12/3/2013 16:10	40.08	3.841	9.785	0.024	37.08	0.024
12/3/2013 16:10	42.48	3.842	9.787	0.023	39.48	0.023
12/3/2013 16:10	45	3.843	9.783	0.021	42.00	0.021
12/3/2013 16:10	47.64	3.841	9.78	0.024	44.64	0.024
12/3/2013 16:10	50.46	3.842	9.78	0.023	47.46	0.023
12/3/2013 16:10	53.46	3.842	9.779	0.023	50.46	0.023
12/3/2013 16:10	56.64	3.843	9.778	0.019	53.64	0.019
12/3/2013 16:11	. 60	3.845	9.775	0.015	57.00	0.015
12/3/2013 16:11	. 63.6	3.846	9.778	0.013	60.60	
12/3/2013 16:11				0.022		
12/3/2013 16:11						
12/3/2013 16:11						
12/3/2013 16:11	79.8	3.842	9.773	0.022	76.80	0.022

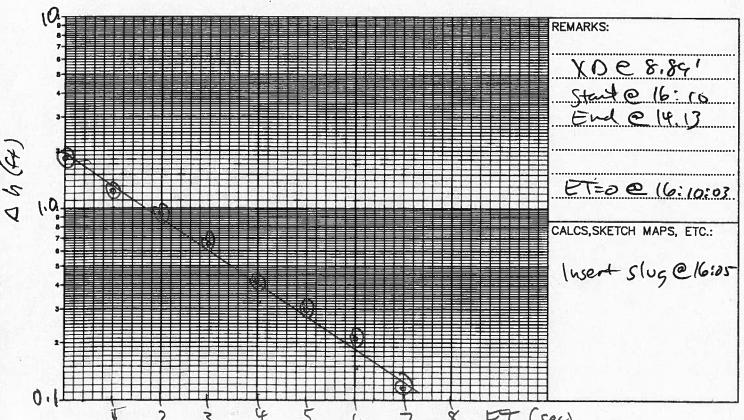
Quarry, NAS Brunswick, ME

MW-QRY-02 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/3/2013 16:11	84.6	3.842	9.775	0.022	81.60	0.022
12/3/2013 16:11	90	3.842	9.772	0.023	87.00	0.023
12/3/2013 16:11	94.8	3.842	9.774	0.022	91.80	0.022
12/3/2013 16:11	100.8	3.842	9.771	0.022	97.80	0.022
12/3/2013 16:11	106.8	3.842	9.772	0.022	103.80	0.022
12/3/2013 16:11	112.8	3.843	9.77	0.021	109.80	0.021
12/3/2013 16:11	119.4	3.842	9.77	0.022	116.40	0.022
12/3/2013 16:12	126.6	3.842	9.771	0.023	123.60	0.023
12/3/2013 16:12	134.4	3.843	9.768	0.021	131.40	0.021
12/3/2013 16:12	142.2	3.843	9.767	0.021	139.20	0.021
12/3/2013 16:12	150.6	3.842	9.767	0.022	147.60	0.022
12/3/2013 16:12	159.6	3.843	9.765	0.02	156.60	0.020
12/3/2013 16:12	169.2	3.843	9.766	0.021	166.20	0.021
12/3/2013 16:12	178.8	3.844	9.767	0.018	175.80	0.018
12/3/2013 16:13	189.6	3.844	9.788	0.018	186.60	0.018



	PROJECT NAI	WE QUARR	y /NAS	BRUNSW	ICK	WELL/BORING	NO.: Mw-Qry-02			
	WELL DIAMET	ER: 2"	45 /1/250 206	NGTH /DEPTH:	10:01	गर	MW-QVLY- ST NO: 02-01-			
	STATIC WATE	R LEVEL (Dept	h/Elevation):	15.70		DA	TE: 12/3/13			
Z	TEST TYPE (I	Rising/Falling/C	Constant Head): .	12 (51	~}-	CHECKED:				
8/8	STATIC WATER LEVEL (Depth/Elevation): \(\lambda \tau \tau \) \(\lambda \tau \tau \tau \tau \tau \tau \tau \ta									
66/90/10	REFERENCE F	T. FOR WL ME	AS. (Top of Casi	ing, Transduce	r, etc.):	PVC				
L'dwg	ELAPSED TIME (min. or (sec.))	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	WELL SCHEMATIC			
ACAD: FORM_HYDCONTST.dwg	0		1.807				BOREHOLE #			
8			1951				4"			
ORM	2		0.930				Depths (TOC)			
CAD	3		0.649							
1	4		0.415		A		14.68			
-	5		0.300	le la			N. S.			
	6		0.207				Z - 3			
-	7		0,114			E Suit				
-	8		0.083				24.68			
-	9		0.070				90,795			
-	10		0.048				✓ Indicate SWL			
L	(1		0.043				Depth on Drawing			





Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

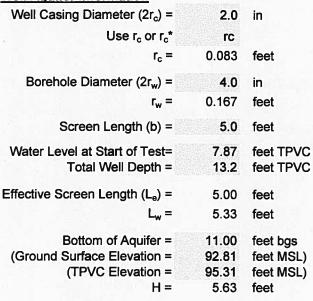
Well Number

Test Type Test Date

MW-QRY-03

Falling Head Calcs By: TSE 12/4/2013 **Checked By: SJC**

Well/Aquifer Information



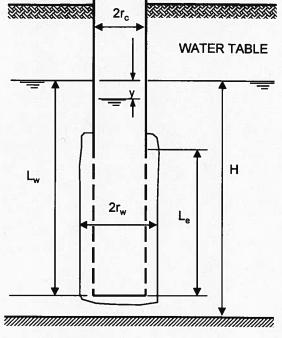
Effective Screen Length (Le) = $L_{a}/r_{w} =$ 30.0

Values from time-drawdown graph

y ₀ =	0.68	feet
y _t =	0.05	feet
t=	34.9	sec

Dimensionless Parameters as Function of Lo/rw

(See page 2 for calcs)



Intermediate Calculations

For Lw < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}} \right]^{-1}$$

In
$$(R_e/r_w) = 2.45$$

For Lw = H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

 $ln (R_e/r_w) = Use formula for Lw<H$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 7.64\text{E-}03 \text{ feet / minute}$$

$$K = 1.10\text{E+}01 \text{ feet / day}$$

$$K = 3.89\text{E-}03 \text{ centimeters / second}$$



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-03

Test Type Test Date

Falling Head 12/4/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= r_w=

5.00 feet 0.167 feet

from page 1

L/r_w=

30.0

log L/r_w=

1.477

Bouwer and Rice Coefficients

A=

2.5

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

0.3

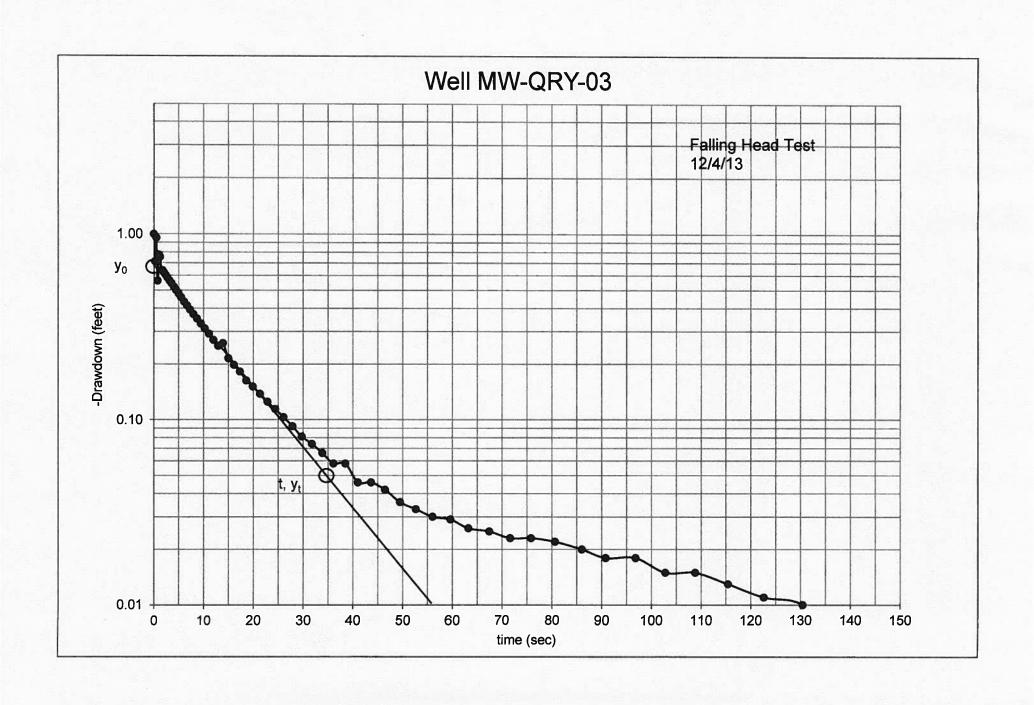
 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

1.9

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$

 $x = \log L/r_w$



MW-QRY-03 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet	
12/4/2013 9:32	0	2.192	9.852	-0.015			
12/4/2013 9:32	0.251	2.192	9.874	-0.014			
12/4/2013 9:32	0.501	2.192	9.886	-0.014			
12/4/2013 9:32	0.751	2.192	9.895	-0.015			
12/4/2013 9:32	1.001	2.192	9.901	-0.015			
12/4/2013 9:32	1.251	2.191	9.913	-0.013			
12/4/2013 9:32	1.501	2.192	9.914	-0.015			
12/4/2013 9:32	1.751	2.192	9.919	-0.015			
12/4/2013 9:32	2.001	2.268	9.922	-0.191			
12/4/2013 9:32	2.251	2.516	9.925	-0.764			
12/4/2013 9:32	2.501	2.712	9.926	-1.215			
12/4/2013 9:32	2.751	2.37	9.929	-0.426			
12/4/2013 9:32	3.001	2.565	9.932	-0.875			
12/4/2013 9:32	3.251	2.56	9.936	-0.865			
12/4/2013 9:32	3.501	2.485	9.936	-0.692			
12/4/2013 9:32	3.751	2.571	9.938	-0.891			
12/4/2013 9:32	4.001	2.617	9.939	-0.995	0.00		0.995 < h
12/4/2013 9:32	4.251	2.494	9.937	-0.713	0.25	5	0.713
12/4/2013 9:32	4.501	2.598	9.939	-0.952	0.50)	0.952
12/4/2013 9:32	4.751	2.429	9.945	-0.561	0.75	5	0.561
12/4/2013 9:32				-0.773	1.00		0.773
12/4/2013 9:32	5.251	2.512	9.946	-0.754	1.25	5	0.754
12/4/2013 9:32	5.501	2.462	9.945	-0.638	1.50		0.638
12/4/2013 9:32	5.751	2.462	9.944	-0.638	1.78	5	0.638
12/4/2013 9:32	6.001	2.455	9.948	-0.622	2.00)	0.622
12/4/2013 9:32	6.36	2.447	9.937	-0.603	2.36	3	0.603
12/4/2013 9:32	6.72	2.438	9.933	-0.582	2.72	2	0.582
12/4/2013 9:32	7.14	2.429	9.925	-0.561	3.14	4	0.561
12/4/2013 9:32	7.56	2.421	9.923	-0.543	3.56	3	0.543
12/4/2013 9:32	8.04	2.411	9.973	-0.52	4.04	4	0.520
12/4/2013 9:32	8.46	2.402	9.945	-0.5	4.46	3	0.500
12/4/2013 9:32	9	2.392	9.93	-0.477	5.00)	0.477
12/4/2013 9:32	9.48	2.384	9.927	-0.457	5.48	3	0.457
12/4/2013 9:32	10.08						0.433
12/4/2013 9:32	10.68	2.365	9.913	-0.413	6.68	3	0.413

MW-QRY-03 Falling Head Test

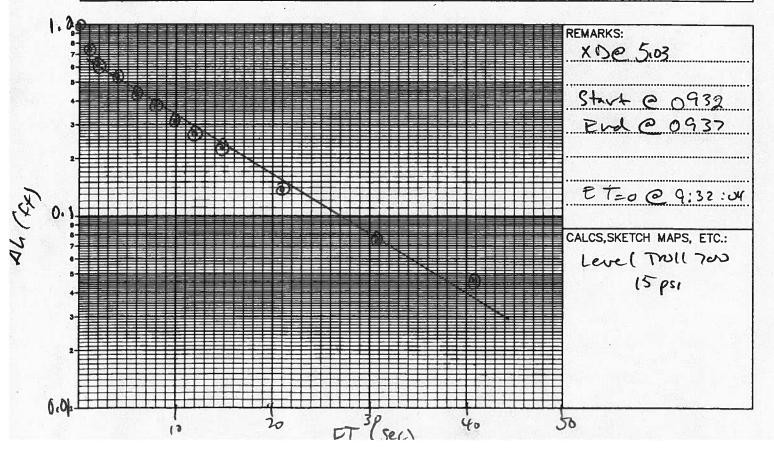
railing Head Test	Elapsed Time	SN#: 164036	SN#: 164036	SN#: 164036	Elapsed Time (Corr)	-Drawdown
Date and Time	Seconds	Pressure (PSI)	Temperature (C)	Level Depth To Water (ft)	seconds	feet
12/4/2013 9:32	11.28	2.355	9.908	-0.392	7.28	0.392
12/4/2013 9:32	11.94	2.346	9.907	-0.371	7.94	0.371
12/4/2013 9:32	12.66	2.338	9.908	-0.351	8.66	0.351
12/4/2013 9:32	13.44	2.328	9.902	-0.33	9.44	0.330
12/4/2013 9:32		2.32	9.9	-0.311	10.22	0.311
12/4/2013 9:32	15.06	2.312	9.899	-0.291	11.06	0.291
12/4/2013 9:32	15.96	2.303	9.895	-0.27	11.96	0.270
12/4/2013 9:32	16.92	2.294	9.893	-0.251	12.92	0.251
12/4/2013 9:32	17.88	2.298	9.893	-0.259	13.88	0.259
12/4/2013 9:32	18.96	2.279	9.89	-0.215	14.96	0.215
12/4/2013 9:32	20.1	2.271	9.89	-0.198	16.10	0.198
12/4/2013 9:32	21.3	2.265	9.892	-0.182	17.30	0.182
12/4/2013 9:32	22.56	2.256	9.89	-0.163	18.56	0.163
12/4/2013 9:32	23.88	2.251	9.891	-0.151	19.88	0.151
12/4/2013 9:32	25.32	2.245	9.887	-0.138	21.32	0.138
12/4/2013 9:32	26.82	2.24	9.888	-0.125	22.82	0.125
12/4/2013 9:32	28.38	2.235	9.885	-0.114	24.38	0.114
12/4/2013 9:32	30.06	2.23	9.884	-0.103	26.06	0.103
12/4/2013 9:32	31.86	2.226	9.885	-0.092	27.86	0.092
12/4/2013 9:32	33.72	2.221	9.882	-0.081	29.72	0.081
12/4/2013 9:32	35.76	2.218	9.881	-0.074	31.76	0.074
12/4/2013 9:32	37.86	2.214	9.881	-0.066	33.86	0.066
12/4/2013 9:32	40.08	2.211	9.881	-0.058	36.08	0.058
12/4/2013 9:32	42.48	2.211	9.877	-0.058	38.48	0.058
12/4/2013 9:32	45	2.206	9.876	-0.046	41.00	0.046
12/4/2013 9:32	47.64	2.205	9.873	-0.046	43.64	0.046
12/4/2013 9:32	50.46	2.204	9.874	-0.042	46.46	0.042
12/4/2013 9:32	53.46	2.201	9.872	-0.036	49.46	0.036
12/4/2013 9:32	56.64	2.2	9.87	-0.033	52.64	0.033
12/4/2013 9:33	60	2.199	9.869	-0.03	56.00	0.030
12/4/2013 9:33	63.6	2.198	9.868	-0.029	59.60	0.029
12/4/2013 9:33	67.2	2.197	9.865	-0.026	63.20	0.026
12/4/2013 9:33	71.4	2.196	9.863	-0.025	67.40	0.025
12/4/2013 9:33	75.6	2.196	9.863	-0.023	71.60	0.023
12/4/2013 9:33	79.8	2.195	9.863	-0.023	75.80	0.023

MW-QRY-03 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet
12/4/2013 9:33	84.6	2.195	9.859	-0.022	80.60	0.022
12/4/2013 9:33	90	2.194	9.858	-0.02	86.00	
12/4/2013 9:33	94.8	2.193	9.856	-0.018	90.80	0.018
12/4/2013 9:33	100.8	2.193	9.856	-0.018	96.80	0.018
12/4/2013 9:33	106.8	2.192	9.852	-0.015	102.80	0.015
12/4/2013 9:33	112.8	2.192	9.851	-0.015	108.80	0.015
12/4/2013 9:33	119.4	2.191	9.847	-0.013	115.40	
12/4/2013 9:34	126.6	2.191	9.846	-0.011		
12/4/2013 9:34	134.4	2.19	9.847	-0.01	130.40	
12/4/2013 9:34	142.2	2.188	9.844	-0.006	138.20	
12/4/2013 9:34	150.6	2.187	9.843	-0.003	146.60	
12/4/2013 9:34	159.6	2.186	9.845	-0.002	155.60	0.002
12/4/2013 9:34	169.2	2.185	9.845	0.002	165.20	-0.002
12/4/2013 9:34	178.8	2.186	9.843	0	174.80	0.000
12/4/2013 9:35	189.6	2.187	9.845	-0.003	185.60	0.003
12/4/2013 9:35	201	2.187	9.844	-0.004	197.00	0.004
12/4/2013 9:35	213	2.187	9.844	-0.004	209.00	0.004
12/4/2013 9:35	225.6	2.186	9.846	-0.001	221.60	0.001
12/4/2013 9:35	238.8	2.185	9.844	0.001	234.80	-0.001
12/4/2013 9:36	253.2	2.181	9.845	0.011	249.20	-0.011
12/4/2013 9:36	268.2	2.182	9.842	0.009	264.20	-0.009
12/4/2013 9:36	283.8	2.18	9.846	0.012	279.80	-0.012
12/4/2013 9:37	300.6	2.18	9.844	0.013	296.60	
12/4/2013 9:37	318.6	2.177	9.845	0.02	314.60	-0.020
12/4/2013 9:37	337.231	2.175	9.88	0.024	333.23	-0.024



37/06/99 INL	PROJECT NO. WELL DIAMET STATIC WATE TEST TYPE (METHOD OF	INDUCING WATE	Y / NAS USCREEN L Constant Head): CREVEL CHANG AS. (Top of Cas	GEOLOGIST: ENGTH/DEPTH: 7,87/- FALLI SE: PVL SI	T. E. 5.0 A+ 18VC vg (0:1'9	DA CHECKED:	ST NO.: IE:).3	Falling 14/U
dwg	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	WELL SCH	EMATIC -WELL # 2 "
HYDCONTST.dwg	0,0		-0.995	0.0		-0,311		BOREHOLE Ø
Š	0.75		-0,952	11.0		-0,291		4"
OR M	1.0		-0,773	12.0		-0.270		Depths (TOC)
CAD: FORM	1.75		-0.638	(50		-0.215	V ₂ S	7, 2
۲	2.0		-0:622	17.0		-0.182	A	8.2
	3.0		-0.561	21.0		-0.178		
	4.0		-0.520	31.0		-0.074		
	5.0		-0,477	41.0		-0.046	SE SE	
	6.0		-0.433	52.0		-0.033		13.2
	7.0		-0.392				() () () () () () () () () ()	13.7'
	8.0		-0.371				✓ Indic	
	9.0		-0.330				Depth on	Drawing Drawing



TE TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

Well Number

Test Type

Test Date

MW-QRY-01B

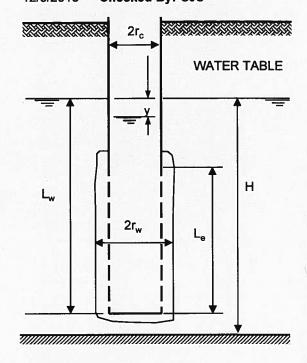
Calcs By: TSE Rising Head 12/3/2013 **Checked By: SJC**

Well/Aquifer Information

13.18

60.0

feet



Values from time-drawdown graph

y ₀ =	1.61	feet
y _t =	0.05	feet
t=	6.0	sec

Intermediate Calculations

For L_w < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln(H - L_{w})/r_{w})}{L_{e}/r_{w}} \right]^{1}$$

In (R_e/r_w) = Use formula for Lw=H

Dimensionless Parameters as Function of La/r...

Le/rw =

(See page 2 for calcs)

For Lw = H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 3.28$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 3.96\text{E-02 feet / minute}$$

$$K = 5.70\text{E+01 feet / day}$$

$$K = 2.01\text{E-02 centimeters / second}$$

Notes



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-03

Test Type Test Date

Rising Head 12/4/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

from page 1

L/r_w=

30.0

log L/r_w=

1.477

Bouwer and Rice Coefficients

2.5

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

0.3

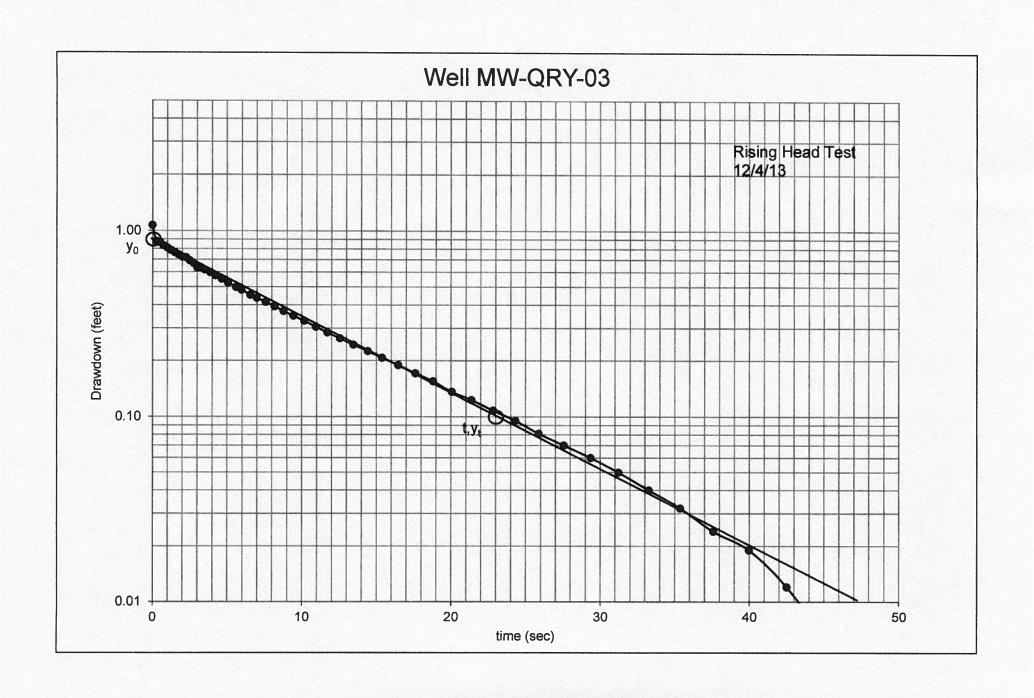
 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

1.9

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$

$$x = log L/r_w$$



MW-QRY-03 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 10:35	· · · · · · · · · · · · · · · · · · ·	2.151	9.832	-0.035		
12/4/2013 10:35	0.251	2.151	9.855	-0.033		
12/4/2013 10:35	0.501	2.151	9.867	-0.034		
12/4/2013 10:35	0.751	2.15	9.876	-0.031		
12/4/2013 10:35	1.001	2.15	9.883	-0.032		
12/4/2013 10:35	1.251	2.15	9.891	-0.033		
12/4/2013 10:35	1.501	2.15	9.896	-0.032		
12/4/2013 10:35	1.751	2.15	9.899	-0.032		
12/4/2013 10:35	2.001	1.512	9.904	1.44		
12/4/2013 10:35	2.251	2.04	9.907	0.223		
12/4/2013 10:35	2.501	1.673	9.908	1.069	0.00	1.069 <
12/4/2013 10:35	2.751	1.757	9.912	0.876	0.25	0.876
12/4/2013 10:35						
12/4/2013 10:35						
12/4/2013 10:35						
12/4/2013 10:35						
12/4/2013 10:35						
12/4/2013 10:35						
12/4/2013 10:35		1.823	9.922	0.722	2.00	0.722
12/4/2013 10:35	4.751	1.826	9.923	0.717	2.25	0.717
12/4/2013 10:35	5.001	1.838	9.923	0.69	2.50	0.690
12/4/2013 10:35	5.251	1.847	9.926	0.668	2.75	0.668
12/4/2013 10:35	5.501	1.863	9.927	0.632	3.00	0.632
12/4/2013 10:35	5.751	1.862	9.925	0.633	3.25	0.633
12/4/2013 10:35	6.001	1.869	9.931	0.616	3.50	0.616
12/4/2013 10:35	6.36	1.878	9.921	0.596	3.86	0.596
12/4/2013 10:35	6.72	1.888	9.914	0.574	4.22	0.574
12/4/2013 10:35	7.14	1.898	9.909	0.55	4.64	0.550
12/4/2013 10:35	7.562	1.909	9.906	0.524	5.06	0.524
12/4/2013 10:35	8.101	1.921	9.897	0.497		
12/4/2013 10:35	8.46	1.928	9.902	0.481		
12/4/2013 10:35	9.054	1.941	9.892	0.452		
12/4/2013 10:35						
12/4/2013 10:35	10.08	1.957	9.895			
12/4/2013 10:35	10.68	1.967	9.889	0.392	8.18	0.392

MW-QRY-03 Rising Head Test

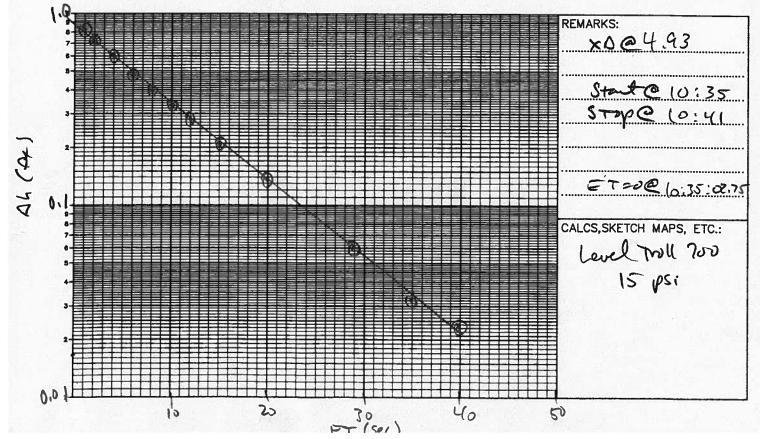
Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 10:35	11.28	1.976	9.891	0.37	8.78	0.37
12/4/2013 10:35	11.94	1.985	9.887	0.349	9.44	0.34
12/4/2013 10:35	12.66	1.994	9.883	0.328	10.16	0.32
12/4/2013 10:35	13.44	2.004	9.881	0.305	10.94	0.30
12/4/2013 10:35	14.22	2.013	9.882	0.284	11.72	0.28
12/4/2013 10:35	15.06	2.022	9.881	0.264	12.56	0.26
12/4/2013 10:35	15.96	2.03	9.883	0.244	13.46	0.24
12/4/2013 10:35	16.92	2.039	9.879	0.225	14.42	0.22
12/4/2013 10:35	17.88	2.047	9.878	0.207	15.38	0.20
12/4/2013 10:35	18.96	2.055	9.876	0.189	, 16.46	0.18
12/4/2013 10:35	20.113	2.062	9.876	0.171	17.61	0.17
12/4/2013 10:35	21.3	2.069	9.876	0.155	18.80	0.19
12/4/2013 10:35	22.56	2.077	9.875	0.136	20.06	0.10
12/4/2013 10:35	23.88	2.083	9.875	0.123	21.38	0.12
12/4/2013 10:35	25.32	2.09	9.871	0.108	22.82	2. 0.10
12/4/2013 10:35	26.82	2.095	9.875	0.095	24.32	2.0.09
12/4/2013 10:35	28.38	2.101	9.875	0.081	25.88	0.08
12/4/2013 10:35	30.06	2.106	9.875	0.07	27.56	0.07
12/4/2013 10:35	31.86	2.11	9.875	0.06	29.36	0.06
12/4/2013 10:35	33.72	2.115	9.873	0.05	31.22	0.05
12/4/2013 10:35	35.76	2.119	9.873	0.04	33.26	0.04
12/4/2013 10:35	37.86	2.122	9.872	0.032	35.36	0.03
12/4/2013 10:35	40.08	2.126	9.874	0.024	37.58	0.02
12/4/2013 10:35	42.48	2.128	9.871	0.019	39.98	0.0
12/4/2013 10:35	45	2.131	9.872	0.012	42.50	0.0
12/4/2013 10:35	47.64	2.134	9.87	0.006	45.14	0.00
12/4/2013 10:35	50.46	2.135	9.871	0.002	47.96	0.00
12/4/2013 10:35	53.46	2.137	9.869	-0.002	50.96	-0.00
12/4/2013 10:35	56.64	2.14	9.87	-0.008		
12/4/2013 10:36	60	2.141	9.872	-0.01	57.50	-0.0
12/4/2013 10:36	63.6	2.141	9.871	-0.011		
12/4/2013 10:36	67.2	2.142	9.87	-0.014		
12/4/2013 10:36	71.4	2.144	9.87			
12/4/2013 10:36	75.6	2.145				
12/4/2013 10:36	79.8	2.146	9.87	-0.022	77.30	-0.02

MW-QRY-03 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 10:36	84.6	2.147	9.874	-0.024	82.10	-0.024
12/4/2013 10:36	90	2.147	9.875	-0.024	87.50	-0.024
12/4/2013 10:36	94.8	2.147	9.873	-0.026	92.30	-0.026
12/4/2013 10:36	100.8	2.146	9.872	-0.023	98.30	-0.023
12/4/2013 10:36	106.8	2.147	9.874	-0.025	104.30	-0.025
12/4/2013 10:36	112.8	2.146	9.872	-0.023	110.30	-0.023
12/4/2013 10:36	119.4	2.145	9.872	-0.02	116.90	-0.020
12/4/2013 10:37	126.6	2.145	9.87	-0.019	124.10	-0.019
12/4/2013 10:37	134.4	2.146	9.872	-0.022	131.90	-0.022
12/4/2013 10:37	142.2	2.147	9.871	-0.026	139.70	-0.026
12/4/2013 10:37	150.6	2.148	9.87	-0.027	148.10	-0.027
12/4/2013 10:37	159.6	2.148	9.87	-0.027	157.10	-0.027
12/4/2013 10:37	169.2	2.149	9.873	-0.029	166.70	-0.029
12/4/2013 10:37	178.8	2.15	9.869	-0.031	176.30	-0.031
12/4/2013 10:38	189.6	2.151	9.875	-0.033	187.10	-0.033
12/4/2013 10:38	201	2.151	9.875	-0.034	198.50	-0.034
12/4/2013 10:38	213	2.153	9.873	-0.039	210.50	-0.039
12/4/2013 10:38	225.6	2.154	9.876	-0.04	223.10	-0.040
12/4/2013 10:38	238.8	2.155	9.878	-0.042	236.30	-0.042
12/4/2013 10:39	253.2	2.156	9.879	-0.046	250.70	-0.046
12/4/2013 10:39	268.2	2.159	9.884	-0.051	265.70	-0.051
12/4/2013 10:39	283.8	2.161	9.887	-0.057	281.30	-0.057
12/4/2013 10:40	300.6	2.162	9.888	-0.059	298.10	-0.059
12/4/2013 10:40	318.6	2.164	9.891	-0.063	316.10	-0.063
12/4/2013 10:40	337.2	2.164	9.888	-0.065	334.70	-0.065
12/4/2013 10:40	357.912	2.163	9.907	-0.062	355.41	-0.062
12/4/2013 10:41	378.768	2.167	9.918	-0.071	376.27	-0.071



3	PROJECT NA	ME QUARR	y / NAS	BRUNSW	ICK	WELL/BORING	10: Ma-quy-0
	PROJECT NO.	1125-006	15/11260206	GEOLOGIST:	l. E	UANS	***************************************
	WELL DIAMET	ER: 2"	SCREEN L	ENGTH /DEPTH:	5.01	TE	ST NO. PULLING ST
	STATIC WATE	R LEVEL (Dent	h (Flevation):	7.88	TPVL	DA	FILL -014 -0 ST NO.:
_	TEST TYPE (Ricin			1E:L
Ĭ.	IEST THE	Kising/railing/C	constant read):	D. 16	Str. (a)	CHECKED:	
8/99							PAGE OF
66/90/10	REFERENCE F	PT. FOR WL ME	AS. (Top of Cas	ing, Transduce	or, etc.):	PVC	
0.4	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL	DRAWDOWN OR HEAD (ΔΗ)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL	DRAWDOWN OR HEAD (ΔΗ)	WELL SCHEMATIC
ST.d		(feet)	(feet)	DESCRIPTION OF THE PROPERTY OF THE PERSON OF	(feet)	(feet)	WELL # 2"
8	0.0		1,069	35-0		0.032	BOREHOLE #
욁	1.0		808.0	40.0		450,0	4"
8	2.0		0.717				Depths (TOC)
ACAD: FORM_HYDCONTST.dwg	4.0		0.594	18 18 1 V	III SA		7.2
8	6.0		0.481				8.2
	8.0		0.392				¥ 7 8.2
	10.0		0.328		XIII		
	12.0	#2	0.284				S-R-1
	15.0		0.207				13.2
	17-0		0.189				13.7
	20.0		0.136				
9	29.0		0.060				✓ Indicate SWL Depth on Drawing



TE TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

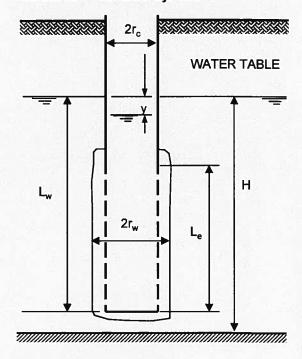
Well Number

MW-QRY-07

Test Type Test Date Falling Head Calcs By: TSE 12/5/2013 Checked By: SJC

Well/Aquifer Information

Well Casing Diameter (2r _c) =	2.0	in
Use r _c or r _c *	rc	
$r_c =$	0.083	feet
Borehole Diameter (2r _w) =	4.0	in
r _w =	0.167	feet
Screen Length (b) =	10.0	feet
Water Level at Start of Test=	3.78	feet TPVC
Total Well Depth =	29.7	feet TPVC
Effective Screen Length (L _e) =	10.00	feet
L _w =	25.92	feet
Bottom of Aquifer =	27.17	feet bgs
(Ground Surface Elevation =	90.91	feet MSL)
(TPVC Elevation =	93.44	feet MSL)
H=	25.92	feet
L _e /r _w =	60.0	



Values from time-drawdown graph

y ₀ =	2.40	feet
y _t =	0.30	feet
t =	340.0	sec

Intermediate Calculations

For L_w < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{u}/r_{w})} + \frac{A + B \ln((H - L_{u})/r_{w})}{L_{e}/r_{w}} \right]^{1}$$

In (R_e/r_w) = Use formula for Lw=H

Dimensionless Parameters as Function of La/r...

(See page 2 for calcs)

For Lw = H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 3.69$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 4.70\text{E-04 feet/minute}$$

$$K = 6.77\text{E-01 feet/day}$$

$$K = 2.39\text{E-04 centimeters/second}$$



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-07

Test Type Test Date

Falling Head 12/5/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

10.00 feet

0.167 feet

from page 1

L/r_w=

60.0

log L/r_w=

1.778

Bouwer and Rice Coefficients

3.5

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

0.5

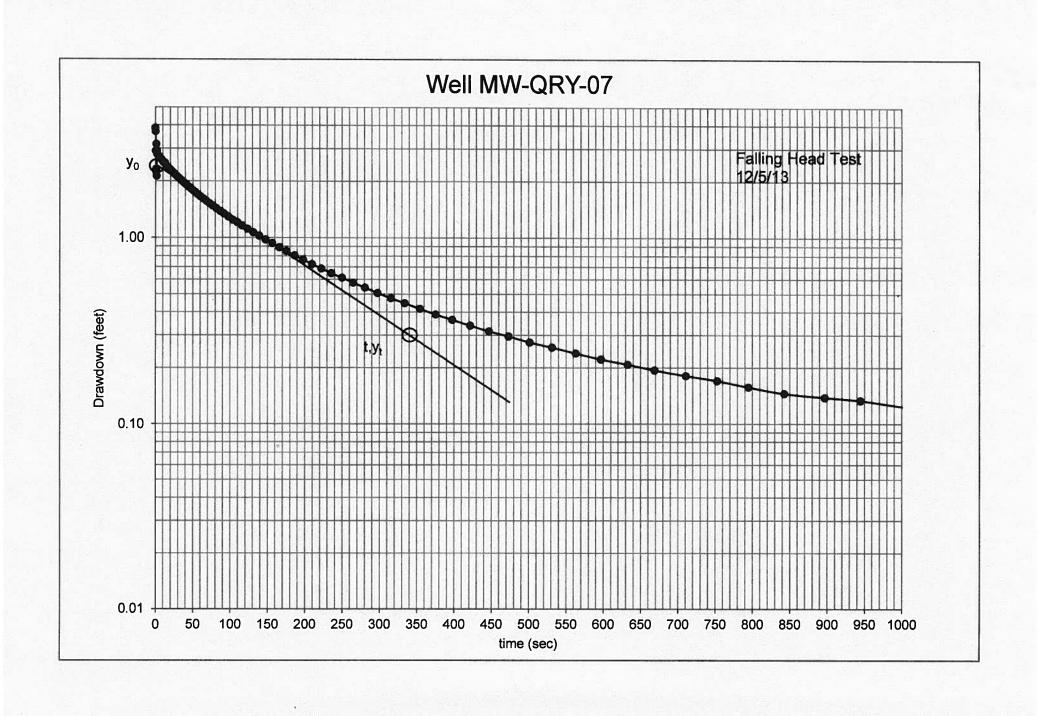
 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

3.2

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$

 $x = log L/r_w$



MW-QRY-07 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet	
12/5/2013 10:12	0	11.025	9.269	-0.018			
12/5/2013 10:12	0.251	11.024	9.289	-0.015			
12/5/2013 10:12	0.501	11.024	9.299	-0.016			
12/5/2013 10:12	0.751	11.063	9.313	-0.105			
12/5/2013 10:12	1.001	11.209	9.322	-0.442			
12/5/2013 10:12	1.251	11.499	9.326	-1.111			
12/5/2013 10:12	1.501	. 11.595	9.329	-1.333			
12/5/2013 10:12	1.751	. 11.713	9.336	-1.606			
12/5/2013 10:12	2.001	11.974	9.338	-2.208			
12/5/2013 10:12	2.251	12.1	9.342	-2.499			
12/5/2013 10:12	2.501	12.043	9.343	-2.367			
12/5/2013 10:12	2.751	12.333	9.346	-3.037			
12/5/2013 10:12	3.001	12.492	9.349	-3.404			
12/5/2013 10:12	3.251	12.687	9.35	-3.854	0.0	0	3.854 < h
12/5/2013 10:12	3.501	12.617	9.353	-3.692	0.2	5	3.692
12/5/2013 10:12	3.751	12.277	9.351	-2.908	0.5	0	2.908
12/5/2013 10:12	4.001	11.992	9.357	-2.249	0.7	5	2.249
12/5/2013 10:12	4.251	12.023	9.353	-2.321	1.0	0	2.321
12/5/2013 10:12	4.501	12.388	9.357	-3.165	1.2	5	3.165
12/5/2013 10:12	4.751	11.937	9.356	-2.123	1.5	0	2.123
12/5/2013 10:12	5.001	12.285	9.359	-2.926	1.7	5	2.926
12/5/2013 10:12	5.251	12.241	9.361	-2.824	2.0	0	2.824
12/5/2013 10:12	5.501	12.229	9.36	-2.796	2.2	5	2.796
12/5/2013 10:12	5.751	12.226	9.364	-2.789	2.5	0	2.789
12/5/2013 10:12	6.001	12.221	9.363	-2.778			2.778
12/5/2013 10:12	6.361	12.215	9.353	-2.766	3.1	1	2.766
12/5/2013 10:12	6.721						2.755
12/5/2013 10:12	7.141	12.204	9.345	-2.74	3.8	9	2.740
12/5/2013 10:12	7.561	12.198	9.338	-2.725	4.3	1	2.725
12/5/2013 10:12	7.98	12.192	9.337	-2.711	4.7	3	2.711
12/5/2013 10:12							2.700
12/5/2013 10:12							2.677
12/5/2013 10:12							2.668
12/5/2013 10:12							2.644
12/5/2013 10:12	10.681	12.158	9.323	-2.632	7.43	3	2.632

MW-QRY-07 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet
12/5/2013 10:12	11.297	12.15	9.322	-2.615	8.05	2.61
12/5/2013 10:12	11.94	12.137	9.322			
12/5/2013 10:12	12.66	12.129	9.318	-2.566		
12/5/2013 10:12	13.44	12.117	9.321	-2.538	10.19	
12/5/2013 10:12	14.22	12.107	9.316	-2.515	10.97	
12/5/2013 10:12	15.061	12.099	9.314	-2.496	11.81	
12/5/2013 10:12	15.96	12.102	9.313	-2.505		
12/5/2013 10:12	16.921	12.079	9.311			
12/5/2013 10:12	17.881	12.066	9.312	-2.42		
12/5/2013 10:12	18.961	12.054	9.31			
12/5/2013 10:12	20.101	12.043	9.309			
12/5/2013 10:12	21.301	12.031	9.307			
12/5/2013 10:12	22.561	12.018	9.307			
12/5/2013 10:12	23.88	12.005	9.309			
12/5/2013 10:12	25.321	11.992	9.307			
12/5/2013 10:12	26.821	11.979	9.307			
12/5/2013 10:12	28.381	11.965				
12/5/2013 10:12	30.061	11.951				
12/5/2013 10:12	31.861	11.936	9.304	-2.12		
12/5/2013 10:12	33.72	11.92	9.303	-2.085	30.47	
12/5/2013 10:12	35.761	11.905	9.304			
12/5/2013 10:12	37.861	11.889	9.303	-2.011	34.61	
12/5/2013 10:12	40.081	11.873	9.301	-1.975	36.83	
12/5/2013 10:12	42.481	11.857	9.299	-1.938	39.23	
12/5/2013 10:12	45.001	11.84	9.299	-1.898	41.75	
12/5/2013 10:12	47.64	11.822	9.298	-1.858	44.39	
12/5/2013 10:12	50.46	11.804	9.297	-1.817	47.21	
12/5/2013 10:12	53.461	11.787	9.297	-1.777	50.21	1.77
12/5/2013 10:12	56.641	11.769	9.292	-1.735	53.39	
12/5/2013 10:13	60	11.75	9.292	-1.691	56.75	
12/5/2013 10:13	63.601	11.732	9.292			
12/5/2013 10:13	67.2	11.713	9.29			
12/5/2013 10:13		11.694				
12/5/2013 10:13	75.6	11.674	9.29	-1.517		
12/5/2013 10:13	79.801	11.657	9.289	-1.475		

MW-QRY-07 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet
12/5/2013 10:13		11.637	9.29	-1.43	81.35	1.43
12/5/2013 10:13	90.001	11.616	9.291	-1.381	86.75	1.38
12/5/2013 10:13	94.801	11.598	9.288	-1.34	91.55	1.34
12/5/2013 10:13		11.576	9.287	-1.289	97.55	1.28
12/5/2013 10:13	106.801	11.554	9.287	-1.239	103.55	1.23
12/5/2013 10:13	112.8	11.539	9.289	-1.203	109.55	1.20
12/5/2013 10:13	119.4	11.518	9.284	-1.156	116.15	1.15
12/5/2013 10:14	126.6	11.499	9.281	-1.111	123.35	1.11
12/5/2013 10:14	134.4	11.478	9.281	-1.063	131.15	1.06
12/5/2013 10:14	142.2	11.46	9.284	-1.021	138.95	1.02
12/5/2013 10:14	150.6	11.44	9.284	-0.976	147.35	0.97
12/5/2013 10:14	159.601	11.422	9.279	-0.934	156.35	0.93
12/5/2013 10:14	169.2	11.402	9.28	-0.888	165.95	0.88
12/5/2013 10:14	178.801	11.385	9.277	-0.848	175.55	0.84
12/5/2013 10:15	189.6	11.366	9.276	-0.805	186.35	0.80
12/5/2013 10:15	201.001	11.349	9.277	-0.764	197.75	0.76
12/5/2013 10:15	213.001	11.331	9.277	-0.723	209.75	0.72
12/5/2013 10:15	225.6	11.314	9.276	-0.685	222.35	0.68
12/5/2013 10:15	238.801	11.298	9.275	-0.647	235.55	0.64
12/5/2013 10:16	253.2	11.283	9.274	-0.612	249.95	0.61
12/5/2013 10:16	268.2	11.267	9.274	-0.575	264.95	0.57
12/5/2013 10:16	283.8	11.252	9.274	-0.541	280.55	0.54
12/5/2013 10:17	300.6	11.237	9.276	-0.506	297.35	0.50
12/5/2013 10:17	318.6	11.223	9.273	-0.474	315.35	0.47
12/5/2013 10:17	337.2	11.21	9.273	-0.445	333.95	0.44
12/5/2013 10:17	357.6	11.197	9.27	-0.415	354.35	0.41
12/5/2013 10:18	378.6	11.185	9.273	-0.387	375.35	0.38
12/5/2013 10:18	400.8	11.174	9.275	-0.362	397.55	0.36
12/5/2013 10:19	424.8	11.164	9.272	-0.337	421.55	0.33
12/5/2013 10:19	450.001	11.153	9.27	-0.314	446.75	0.31
12/5/2013 10:19	476.4	11.146	9.271	-0.295	473.15	0.29
12/5/2013 10:20	504.6	11.136	9.27	-0.274	501.35	0.27
12/5/2013 10:20	534.6	11.129	9.269	-0.257	531.35	0.25
12/5/2013 10:21	566.4	11.121	9.268	-0.239	563.15	0.23
12/5/2013 10:22	600	11.114	9.267	-0.222	596.75	0.22

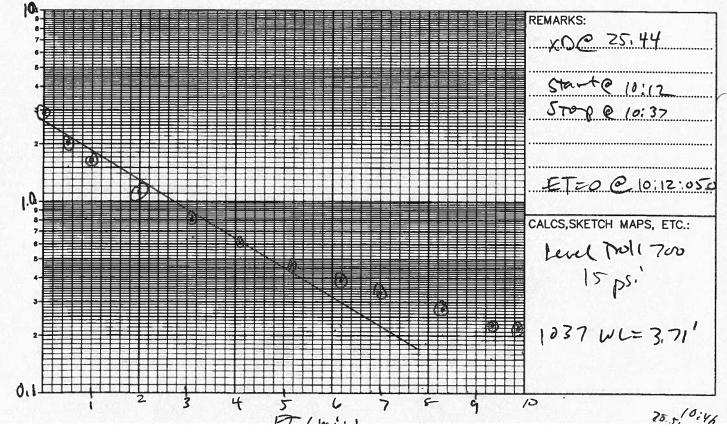
Quarry, NAS Brunswick, ME

MW-QRY-07 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet
12/5/2013 10:22	63	6 11.108	9.27	-0.208	632.75	0.208
12/5/2013 10:23	67	2 11.102	9.27	-0.194	668.75	0.194
12/5/2013 10:23	71	4 11.096	9.268	-0.181	710.75	0.181
12/5/2013 10:24	75	6 11.091	9.27	-0.17	752.75	0.170
12/5/2013 10:25	79	8 11.086	9.269	-0.157	794.75	0.157
12/5/2013 10:26	84	6 11.08	9.269	-0.145	842.75	0.145
12/5/2013 10:27	90	0 11.078	9.27	-0.138	896.75	0.138
12/5/2013 10:27	94	8 11.075	9.27	-0.133	944.75	0.133
12/5/2013 10:28	100	8 11.071	9.271	-0.123	1004.75	0.123
12/5/2013 10:29	106	8 11.068	9.269	-0.116	1064.75	0.116
12/5/2013 10:30	112	8 11.065	9.282	-0.109	1124.75	0.109
12/5/2013 10:31	118	8 11.061	9.275	-0.1	1184.75	0.100
12/5/2013 10:32	124	8 11.058	9.275	-0.094	1244.75	0.094
12/5/2013 10:33	130	8 11.056	9.276	-0.089	1304.75	0.089
12/5/2013 10:34	136	8 11.055	9.274	-0.085	1364.75	0.085
12/5/2013 10:35	142	8 11.053	9.276	-0.081	1424.75	0.081
12/5/2013 10:36	148	8 11.053	9.276	-0.081	1484.75	0.081



	PROJECT NO.	1175006	15/2063	GEOLOGIST:	T. Evan	5	NO.: MW-ORY-D
	WELL DIAMET	ER: 2"	ТЕЗ	ST NO.: FALLINGO			
	STATIC WATE	R LEVEL (Depti	h/Elevation):	3,78		DA	TE: 12/5/13
Z	TEST TYPE (I	Rising/Falling/C	Constant Head):	Falla	X	CHECKED:	
66/	METHOD OF I	INDUCING WATE	R LEVEL CHANG	E: DVC S	lug (0.11	0 x 7.7')	PAGE OF
66/90/10			AS. (Top of Cas				
L'dwg	ELAPSED TIME (min. or (sec.))	MEASURED WATER LEVEL (foot)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	WELL SCHEMATIC
ACAD: FORM_HYDCONTST.dwg	0.0	0.0 min	-2.926				BODEHOLE &
8	70	0.8	-2.049				7 44
S.		-)	-1.649				Depths (TOC)
SADE		2.1	1.111				Depths (TOC)
*		3.1	-0.805		#10		19,7
		4.1	-0.6/2				YIERWAL .
		5,2	-0.474				
		0.2	-0.387				SEEN
		7	-0.337				29.7
		8:3	-0.274				GRAV
		9.35	-0.234				7
		9.9	-0.222				✓ Indicate SWL Depth on Drawing



TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

Well Number

Test Type Test Date

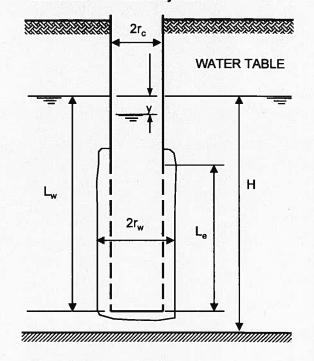
MW-QRY-07

Rising Head Calcs By: TSE 12/5/2013 Checked By: SJC

Well/Aquifer Information Well Casing Diameter (2r_c) = 2.0 in Use rc or rc* C 0.083 feet Borehole Diameter (2rw) = 4.0 in 0.167 feet 10.0 Screen Length (b) = feet 3.77 feet TPVC Water Level at Start of Test= Total Well Depth = 29.7 feet TPVC Effective Screen Length (Le) = 10.00 feet 25.93 feet Bottom of Aquifer = 27.17 feet bgs (Ground Surface Elevation = 90.91 feet MSL) (TPVC Elevation = 93.44 feet MSL) 25.93 feet

Le/rw =

60.0



Values from time-drawdown graph

y ₀ =	2.50	feet
y _t =	0.30	feet
t =	340	sec

Intermediate Calculations

For Lw < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}} \right]^{1}$$

In (R_e/r_w) = Use formula for Lw=H

Dimensionless Parameters as Function of La/r.,

(See page 2 for caics)

For Lw = H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 3.69$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 4.79E-04 \text{ feet / minute}$$

$$K = 6.90E-01 \text{ feet / day}$$

$$K = 2.44E-04 \text{ centimeters / second}$$



Project: Quarry

NAS Brunswick, ME

Well Number

MW-QRY-07

Test Type Test Date Rising Head 12/5/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," *Groundwater*, v. 42, no. 5.

L= r_w=

10.00 feet 0.167 feet from page 1

L/r_w=

60.0

log L/r_w=

1.778

Bouwer and Rice Coefficients

A=

3.5 where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

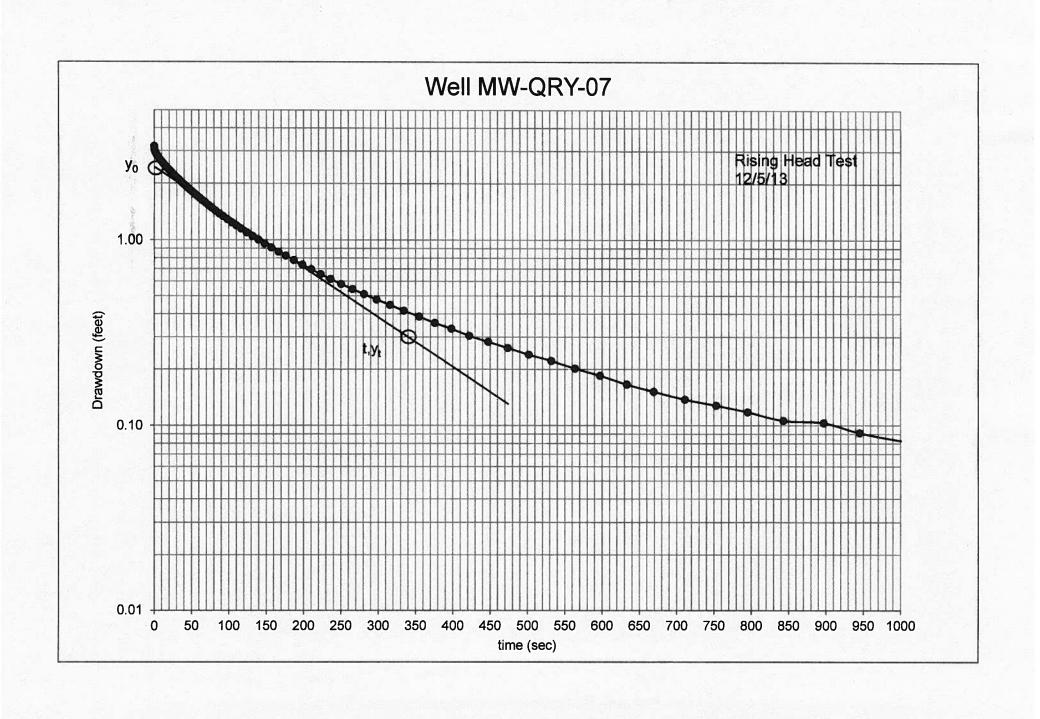
0.5

 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

3.2

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$



MW-QRY-07 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 10:41		11.05	9.277	-0.01		
12/5/2013 10:41	0.25	11.048	9.3	-0.006		
12/5/2013 10:41	. 0.5	11.049	9.314	-0.008		
12/5/2013 10:41	0.75	11.049	9.322	-0.009		
12/5/2013 10:41	1	. 11.047	9.332	-0.004		
12/5/2013 10:41	1.25	11.047	9.335	-0.004		
12/5/2013 10:41	1.5	10.111	9.343	2.157		
12/5/2013 10:41	1.75	9.912	9.343	2.616		
12/5/2013 10:41	. 2	10.503	9.349	1.252		
12/5/2013 10:41	2.25	10.101	9.352	2.18		
12/5/2013 10:41	2.5	9.911	9.354	2.619		
12/5/2013 10:41	2.75	9.668	9.355	3.179	0.00	3.179 <
12/5/2013 10:41	. 3	9.723	9.359			3.052
12/5/2013 10:41						
12/5/2013 10:41						
12/5/2013 10:41						
12/5/2013 10:41						
12/5/2013 10:41						
12/5/2013 10:41			9.366			
12/5/2013 10:41	4.75	9.782	9.371			
12/5/2013 10:41		9.788	9.369	2.903	2.25	2.903
12/5/2013 10:41	5.25	9.793	9.37	2.891	2.50	2.891
12/5/2013 10:41	5.5	9.8	9.369	2.875	2.75	2.875
12/5/2013 10:41	5.75	9.805	9.373	2.863	3.00	2.863
12/5/2013 10:41	6	9.81	9.374	2.853	3.25	2.853
12/5/2013 10:41	6.36	9.816	9.368	2.838	3.61	2.838
12/5/2013 10:41	6.72	9.823	9.36	2.823	3.97	7 2.823
12/5/2013 10:41	7.14	9.83	9.355	2.807	4.39	2.807
12/5/2013 10:41	7.56	9.838	9.353	2.788	4.81	2.788
12/5/2013 10:41	7.98	9.844	9.346	2.774	5.23	3 2.774
12/5/2013 10:41	8.46	9.851	9.343	2.757		
12/5/2013 10:41	9					
12/5/2013 10:41						
12/5/2013 10:41						
12/5/2013 10:41	10.68	9.884	9.335	2.681	7.93	2.681

MW-QRY-07 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
					seconds	·
12/5/2013 10:41	11.28	9.893	9.334	2.661	8.53	2.60
12/5/2013 10:41	11.94	9.901	9.332	2.642	9.19	2.6
12/5/2013 10:41	. 12.66	9.909	9.331	2.623	9.91	2.6
12/5/2013 10:41	. 13.44	9.919	9.327	2.601	10.69	2.6
12/5/2013 10:41	. 14.22	9.931	9.323	2.573	11.47	2.5
12/5/2013 10:41	15.06	9.941	9.326	2.55	12.31	2.5
12/5/2013 10:41	. 15.96	9.952	9.323	2.525	13.21	2.5
12/5/2013 10:41	16.92	9.961	9.321	2.503	14.17	2.5
12/5/2013 10:41	17.88	9.972	9.321	2.478	15.13	2.4
12/5/2013 10:41	18.96	9.984	9.319	2.451	16.21	2.4
12/5/2013 10:41	20.1	9.997	9.317	2.421	17.35	2.4
12/5/2013 10:41	21.3	10.009	9.317	2.393	18.55	2.3
12/5/2013 10:41	. 22.56	10.023	9.318	2.361	19.81	2.3
12/5/2013 10:41	. 23.88	10.036	9.317	2.331	21.13	2.3
12/5/2013 10:41	25.32	10.049	9.315	2.3	22.57	2.3
12/5/2013 10:41	26.82	10.064	9.315	2.266	24.07	2.20
12/5/2013 10:41	28.38	10.078	9.313	2.233	25.63	2.2
12/5/2013 10:41	30.06	10.093	9.315	2.198	27.31	2.1
12/5/2013 10:41	31.86	10.109	9.312	2.163	29.11	2.1
12/5/2013 10:41	. 33.72	10.124	9.311	2.127	30.97	2.13
12/5/2013 10:41	35.76	10.142	9.313	2.086	33.01	2.0
12/5/2013 10:41	. 37.86	10.158	9.31	2.049	35.11	2.0
12/5/2013 10:41	40.08	10.175	9.31	2.009	37.33	2.0
12/5/2013 10:41	42.48	10.192	9.307	1.969	39.73	1.9
12/5/2013 10:41	. 45	10.211	9.308	1.927	42.25	1.9
12/5/2013 10:41	47.64	10.228	9.303	1.886	44.89	1.8
12/5/2013 10:41	50.46	10.247	9.305	1.844	47.71	1.8
12/5/2013 10:41	. 53.46	10.266	9.302	1.8	50.71	1.8
12/5/2013 10:41	56.64	10.285	9.303	1.756	53.89	1.7
12/5/2013 10:42	60	10.304	9.3	1.711	57.25	1.7
12/5/2013 10:42	63.6	10.324	9.303	1.665	60.85	1.60
12/5/2013 10:42	67.2	10.344	9.302	1.619	64.45	1.6
12/5/2013 10:42	71.4	10.365	9.299	1.571	68.65	1.5
12/5/2013 10:42	75.6	10.386	9.3	1.522	72.85	1.5
12/5/2013 10:42		10.405	9.298	1.479	77.05	1.4

MW-QRY-07 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 10:42	84.6	10.426	9.297	1.43	81.85	5 1.430
12/5/2013 10:42	90	10.448	9.293	1.378	87.25	
12/5/2013 10:42	94.8	10.467	9.295	1.335	92.05	1.335
12/5/2013 10:42	100.8	10.489	9.293	1.284	98.05	1.284
12/5/2013 10:42	106.8	10.51	9.292	1.235	104.05	1.235
12/5/2013 10:42	112.8	10.529	9.291	1.191	110.05	1.191
12/5/2013 10:42	119.4	10.55	9.288	1.144	116.65	1.144
12/5/2013 10:43	126.6	10.572	9.286	1.093	123.85	1.093
12/5/2013 10:43	134.4	10.592	9.287	1.046	131.65	1.046
12/5/2013 10:43	142.2	10.612	9.286	1.001	139.45	1.001
12/5/2013 10:43	150.6	10.632	9.286	0.954	147.85	0.954
12/5/2013 10:43	159.6	10.652	9.286	0.908	156.85	0.908
12/5/2013 10:43	169.2	10.672	9.285	0.862	166.45	0.862
12/5/2013 10:43	178.8	10.689	9.284	0.822	176.05	0.822
12/5/2013 10:44	189.6	10.708	9.284	0.778	186.85	0.778
12/5/2013 10:44	201	10.726	9.284	0.736	198.25	0.736
12/5/2013 10:44	213	10.744	9.284	0.695	210.25	0.695
12/5/2013 10:44	225.6	10.762	9.279	0.654	222.85	0.654
12/5/2013 10:44	238.8	10.778	9.283	0.616	236.05	0.616
12/5/2013 10:45	253.2	10.795	9.279	0.578	250.45	0.578
12/5/2013 10:45	268.2	10.81	9.281	0.543	265.45	0.543
12/5/2013 10:45	283.8	10.825	9.28	0.51	281.05	0.510
12/5/2013 10:46	300.6	10.839	9.276	0.477	297.85	0.477
12/5/2013 10:46	318.6	10.852	9.278	0.446	315.85	0.446
12/5/2013 10:46	337.2	10.865	9.278	0.415	334.45	0.415
12/5/2013 10:46	357.6	10.878	9.277	0.386	354.85	0.386
12/5/2013 10:47	378.6	10.891	9.276	0.357	375.85	0.357
12/5/2013 10:47	400.8	10.901	9.277	0.332	398.05	0.332
12/5/2013 10:48	424.8	10.913	9.276	0.304	422.05	0.304
12/5/2013 10:48	450	10.923	9.275	0.282	447.25	0.282
12/5/2013 10:48	476.4	10.932	9.276	0.261	473.65	0.261
12/5/2013 10:49	504.6	10.941	9.276	0.24	501.85	0.240
12/5/2013 10:49	534.6	10.949	9.277	0.222	531.85	0.222
12/5/2013 10:50	566.4	10.958	9.276	0.202	563.65	
12/5/2013 10:51	600	10.965	9.275	0.185	597.25	0.185

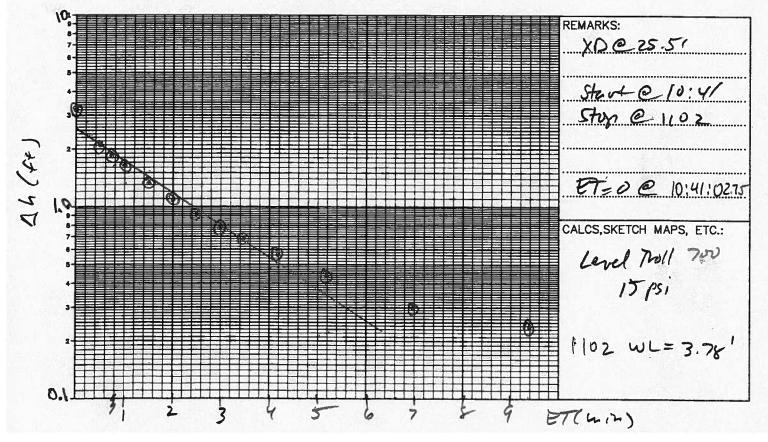
Quarry, NAS Brunswick, ME

MW-QRY-07 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 10:51		10.973	9.274	0.166	633.25	0.166
12/5/2013 10:52	672	10.979	9.274	0.152	669.25	
12/5/2013 10:52		10.986	9.274	0.138	711.25	0.138
12/5/2013 10:53		10.99	9.274	0.128	753.25	0.128
12/5/2013 10:54	798	10.994	9.276	0.118	795.25	0.118
12/5/2013 10:55	846	10.999	9.278	0.106	843.25	
12/5/2013 10:56	899.999	11	9.298	0.103	897.25	0.103
12/5/2013 10:56	947.999	11.006	9.289	0.091	945.25	0.091
12/5/2013 10:57	1008	11.009	9.284	0.082	1005.25	0.082
12/5/2013 10:58	1068	11.012	9.281	0.076	1065.25	
12/5/2013 10:59	1127.999	11.015	9.28	0.07	1125.25	0.070
12/5/2013 11:00	1187.999	11.017	9.279	0.065	1185.25	0.065
12/5/2013 11:01	1248	11.025	9.278	0.046	1245.25	0.046



	PROJECT NAM	ME: QUARR	y / NAS	BRUNSL	nck T.E.	WELL/BORING	NO.: MU-CORY-O
G	WELL DIAMET	ED. 2"	SCOPEN II	ENCTU (DEDTU	10.0		NW-01/407- ST NO.: RISING-02
	STATIC WATE	R LEVEL (Depti	/Elevation):	2,1	7'	DA	TE: 12/5/13
Z	TEST TYPE (F	Rising/Falling/C	onstant Head):	PLISI	ng	CHECKED:	TE: 12/5/13
8	METHOD OF I	NDUCING WATE	R LEVEL CHANG	E: PVC	Slug (0.	1'4 x7.7	PAGE OF
65/90//0	REFERENCE P	T. FOR WL MEA	NS. (Top of Cas	ing, Transduce	er, etc.):	PVC	
ACAD: FORM_HYDCONTST.dwg	ELAPSED TIME (min. or (sec.)	MEASURED WATER LEVEL	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED- WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	WELL SCHEMATIC
2 5	0.0	D.D win	3.179		9.4 wm	6.26	BOREHOLE #
2	30	0.5	2.127		14.	0,106	BOREHOLE 9/1
¥ _	45	0.75	1.886				Depths (TOC)
Ž.		1.0	1,665				Y .
₹[1.5	1.335				19.74
L	8-14-14-14-14-14-14-14-14-14-14-14-14-14-	7	1.093		97 v VA		
		2,5	0.908		24-11-11		
		3	877.0				- EEC - OF E
	IN S	3,5	0.695				
L		4.2	0.578				29.79
		5.2	0.446				
		7	0.304				Indicate SWL Depth on Drawing



TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

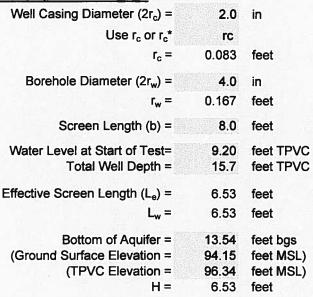
Well Number

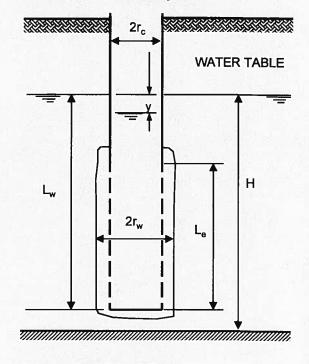
MW-QRY-09

Test Type
Test Date

Rising Head Calcs By: TSE 12/5/2013 Checked By: SJC

Well/Aguifer Information





Values from time-drawdown graph

y ₀ =	0.75	feet
y _t =	0.03	feet
t =	65.0	202

Le/rw =

39.2

Intermediate Calculations

For Lw < H

$$\ln \frac{R_{\rm e}}{r_{\rm w}} = \left[\frac{1.1}{\ln(L_{\rm w}/r_{\rm w})} + \frac{A + B \ln(H - L_{\rm w})/r_{\rm w}}{L_{\rm e}/r_{\rm w}} \right]^{-1}$$

In (R_e/r_w) = Use formula for Lw=H

Dimensionless Parameters as Function of La/r...

(See page 2 for calcs)

For Lw = H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 2.79$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 4.40\text{E-}03 \text{ feet / minute}$$

$$K = 6.34\text{E+}00 \text{ feet / day}$$

$$K = 2.24\text{E-}03 \text{ centimeters / second}$$



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-09

Test Type Test Date

Rising Head 12/5/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= r_w=

6.53 feet 0.167 feet

from page 1

L/rw=

39.2

log L/r_w=

1.593

Bouwer and Rice Coefficients

A=

2.8

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

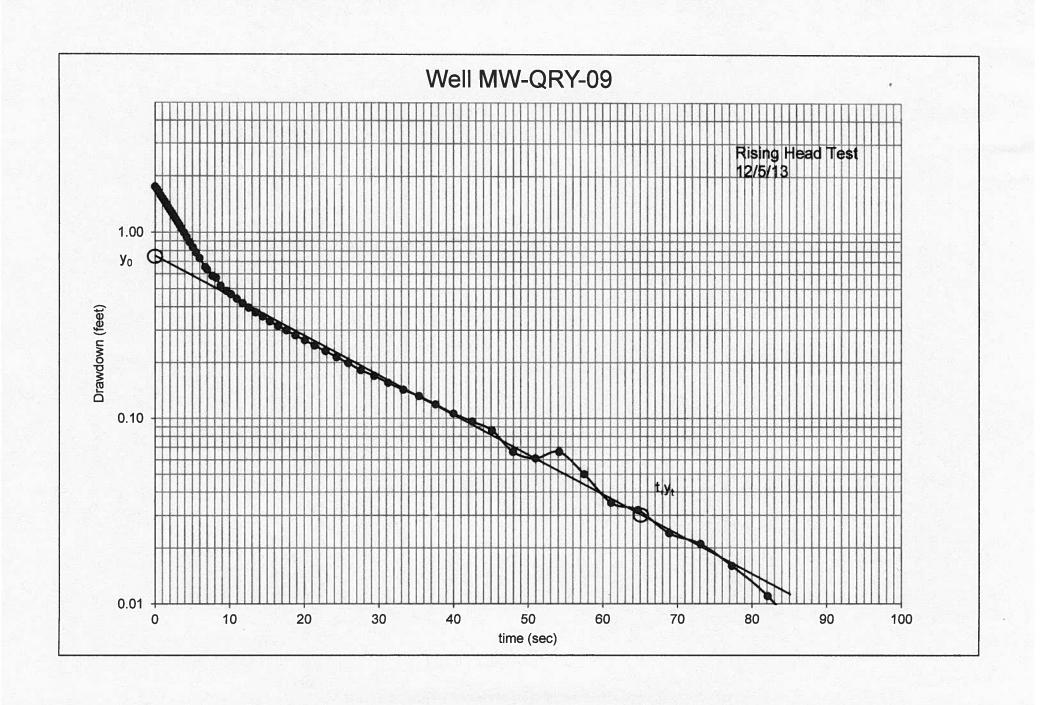
0.4

 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

2.3

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$



MW-QRY-09 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 11:45	5	2.826	10.319	-0.019		
12/5/2013 11:45	0.25	2.827	10.34	-0.02		
12/5/2013 11:45	0.5	2.825	10.351	-0.017		
12/5/2013 11:45	0.75	2.826	10.361	-0.018		
12/5/2013 11:45	1	2.826	10.367	-0.018		
12/5/2013 11:45	1.25	2.825	10.376	-0.017		
12/5/2013 11:45	1.5	2.212	10.381			
12/5/2013 11:45	1.75	2.306	10.383	1.183		
12/5/2013 11:45		2.457	10.39			
12/5/2013 11:45	2.25	2.112	10.391	1.629		
12/5/2013 11:45	2.5	2.061	10.393	1.748	0.00	1.748 <
12/5/2013 11:45	2.75	2.083	10.394	1.696	0.25	1.696
12/5/2013 11:45	3	2.109	10.398			
12/5/2013 11:45	3.25	2.138	10.398			
12/5/2013 11:45	3.5	2.161	10.401	1.517		
12/5/2013 11:45	3.75	2.184	10.4			
12/5/2013 11:45	4	2.207	10.403	1.411	1.50	
12/5/2013 11:45	4.25	2.231	10.408	1.355	1.75	
12/5/2013 11:45	4.5	2.252	10.406	1.308	2.00	
12/5/2013 11:45	4.75	2.27	10.407	1.265	2.25	
12/5/2013 11:45	5	2.291	10.409			
12/5/2013 11:45	5.25	2.309	10.41	1.176	2.75	1.176
12/5/2013 11:45	5.517	2.329	10.41	1.129	3.02	1.129
12/5/2013 11:45	5.75	2.346	10.41	1.091	3.25	1.091
12/5/2013 11:45	= = 6	2.364	10.414	1.049	3.50	1.049
12/5/2013 11:45	6.36	2.387	10.402	0.996	3.86	0.996
12/5/2013 11:45	6.72	2.409	10.399	0.945	4.22	0.945
12/5/2013 11:45		2.434	10.391	0.886	4.64	0.886
12/5/2013 11:45	7.56	2.457	10.39	0.833	5.06	0.833
12/5/2013 11:45	7.98	2.48	10.387	0.782	5.48	0.782
12/5/2013 11:45				0.729	5.96	0.729
12/5/2013 11:45	9.224	2.536	10.372	0.652	6.72	0.652
12/5/2013 11:45				0.633	6.98	0.633
12/5/2013 11:45				0.585	7.68	0.585
12/5/2013 11:45	10.68	2.571	10.373	0.571	8.18	0.571

MW-QRY-09 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet	
12/5/2013 11:45	11.28	2.594	10.372	0.518	8.78	0.	.518
12/5/2013 11:45	12.043	2.608	10.367	0.486			.486
12/5/2013 11:45	12.66	2.616	10.369	0.466	10.16		.466
12/5/2013 11:45	13.44	2.627	10.367	0.441			.441
12/5/2013 11:45	14.22	2.638	10.366	0.417			.417
12/5/2013 11:45	15.06	2.647	10.365	0.395			.395
12/5/2013 11:45	15.96	2.656	10.361	0.373			.373
12/5/2013 11:45	16.92	2.664	10.36				.355
12/5/2013 11:45	17.88	2.674	10.359				.334
12/5/2013 11:45	18.96	2.681	10.359				.316
12/5/2013 11:45	20.1	2.689	10.358	0.299			.299
12/5/2013 11:45	21.3	2.696	10.356	0.281	18.80		.281
12/5/2013 11:45	22.56	2.704	10.355				.264
12/5/2013 11:45	23.88	2.711	10.353				.247
12/5/2013 11:45	25.32	2.718	10.352				.231
12/5/2013 11:45	26.82	2.725	10.353				.214
12/5/2013 11:45	28.38	2.732	10.35	0.199			.199
12/5/2013 11:45	30.06	2.739	10.351	0.182			.182
12/5/2013 11:45	31.86	2.744	10.348				.170
12/5/2013 11:45	33.72	2.751	10.347	0.156	31.22		.156
12/5/2013 11:45	35.76	2.756	10.351	0.143	33.26		.143
12/5/2013 11:45	37.86	2.761	10.347	0.132	35.36		.132
12/5/2013 11:45	40.08	2.767	10.343	0.119			.119
12/5/2013 11:45	42.48	2.772	10.344	0.106	39.98		.106
12/5/2013 11:45	45	2.777	10.344	0.096	42.50		.096
12/5/2013 11:45	47.64	2.781	10.343	0.086	45.14		.086
12/5/2013 11:45	50.46	2.789	10.341	0.066			.066
12/5/2013 11:45	53.46	2.792	10.342	0.061	50.96	0.	.061
12/5/2013 11:45	56.64	2.79	10.341	0.066	54.14		.066
12/5/2013 11:46	60	2.796	10.342	0.05	57.50	0.	.050
12/5/2013 11:46	63.6	2.803	10.342	0.035	61.10		.035
12/5/2013 11:46	67.2	2.804	10.345				.032
12/5/2013 11:46	71.4	2.808	10.341	0.024	68.90		.024
12/5/2013 11:46	75.6	2.809	10.342	0.021	73.10		.021
12/5/2013 11:46	79.8	2.811	10.342	0.016	77.30		.016

Quarry, NAS Brunswick, ME

MW-QRY-09 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 11:46	84.6	2.813	10.348	0.011	82.10	0.011
12/5/2013 11:46	90	2.816	10.345	0.006		
12/5/2013 11:46	94.8	2.817	10.345	0.003		
12/5/2013 11:46	100.8	2.818	10.347	0		
12/5/2013 11:46	106.8	2.82	10.346	-0.004		
12/5/2013 11:46	112.8	2.82	10.35	-0.004		
12/5/2013 11:46	119.399	2.821	10.35			
12/5/2013 11:47	126.6	2.822	10.355	-0.008		
12/5/2013 11:47	134.399	2.823	10.354	-0.012		
12/5/2013 11:47	142.2	2.824	10.359	-0.014		
12/5/2013 11:47	150.6	2.824	10.362	-0.014		
12/5/2013 11:47	159.6	2.824	10.363	-0.013		
12/5/2013 11:47	169.203	2.824	10.367	-0.015		
12/5/2013 11:47	178.8	2.825	10.369	-0.016		
12/5/2013 11:48	189.6	2.825	10.375	-0.016	187.10	
12/5/2013 11:48	201	2.824	10.381	-0.015		
12/5/2013 11:48	213	2.824	10.384	-0.015		
12/5/2013 11:48	225.599	2.827	10.398	-0.02		
12/5/2013 11:48	238.8	2.825	10.399			

Elapsed Time
Date and Time
Seconds

e SN Pr

SN#: 164036 Pressure (PSI)

SN#: 164036 Temperature (C)

SN#: 164036 Elapsed Level Depth To Water (ft) seconds

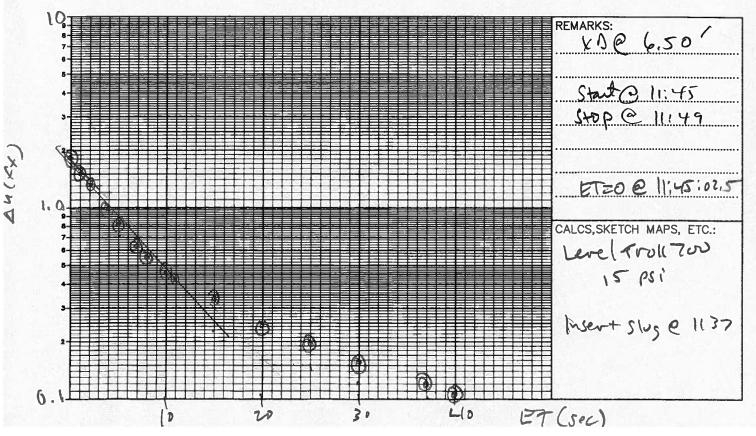
Elapsed Time (Corr) seconds

Drawdown feet





INI	STATIC WATE	R LEVEL (Depti	h/Elevation):	9.20'	••••••	D	G NO.: MW-QRY-09 EST NO.: R.J.ING. ATE: 12/5/13 PAGE 1. OF 1
66/90/10							
01/0	REFERENCE P		AS. (Top of Cas				
gwb.	ELAPSED TIME (min. or sec)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ (feet)	WELL SCHEMATIC WELL # WELL # 4
ACAD: FORM_HYDCONTST.dwg	0,0		1.748	15		0.334	BOREHOLE & 4
2	1,0		1.517	20		0.247	- 41
FORM	2.0		1,308	25		0,199	Depths (TOC)
CAD	3		1,129	39		0.156	Depths (IOC)
1	4	100	0.996	38		0,119	7.73
-	5		0.833	40		0,(06	
-	6		0.729				1 7
-	-		0.633				
-	8		0.571				15.73
+	9		0.518				- (B)
+	0		0.466				✓ Indicate SWL
L	- 11		0,441				Depth on Drawing



(Bouwer, 1989)

Project:

Quarry

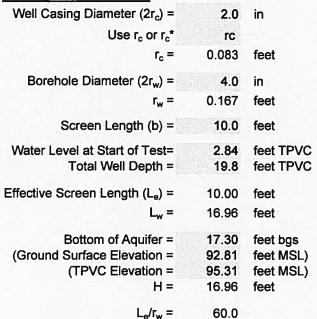
NAS Brunswick, ME

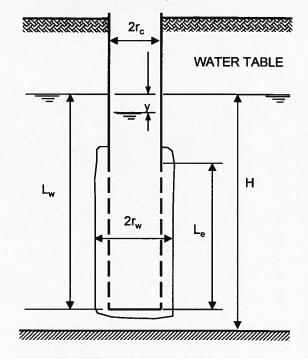
Well Number

MW-QRY-12

Test Type Test Date Falling Head Calcs By: TSE 12/5/2013 Checked By: SJC

Well/Aquifer Information





Values from time-drawdown graph

y ₀ =	1.35	feet
y _t =	0.20	feet
t =	13.5	sec

Intermediate Calculations

For L_w < H

$$\ln \frac{R_{e}}{r_{w}} = \frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}}$$

In (R_e/r_w) = Use formula for Lw=H

Dimensionless Parameters as Function of La/r...

(See page 2 for calcs)

For L_w = H $\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$ $\ln (R_e / r_w) = 3.44$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 1.01\text{E-02 feet/minute}$$

$$K = 1.46\text{E+01 feet/day}$$

$$K = 5.15\text{E-03 centimeters/second}$$



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-12

Test Type Test Date

Falling Head 12/5/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= r_w= 10.00 feet

0.167 feet

from page 1

L/rw=

60.0

log L/r_w=

1.778

Bouwer and Rice Coefficients

A= B= 3.5

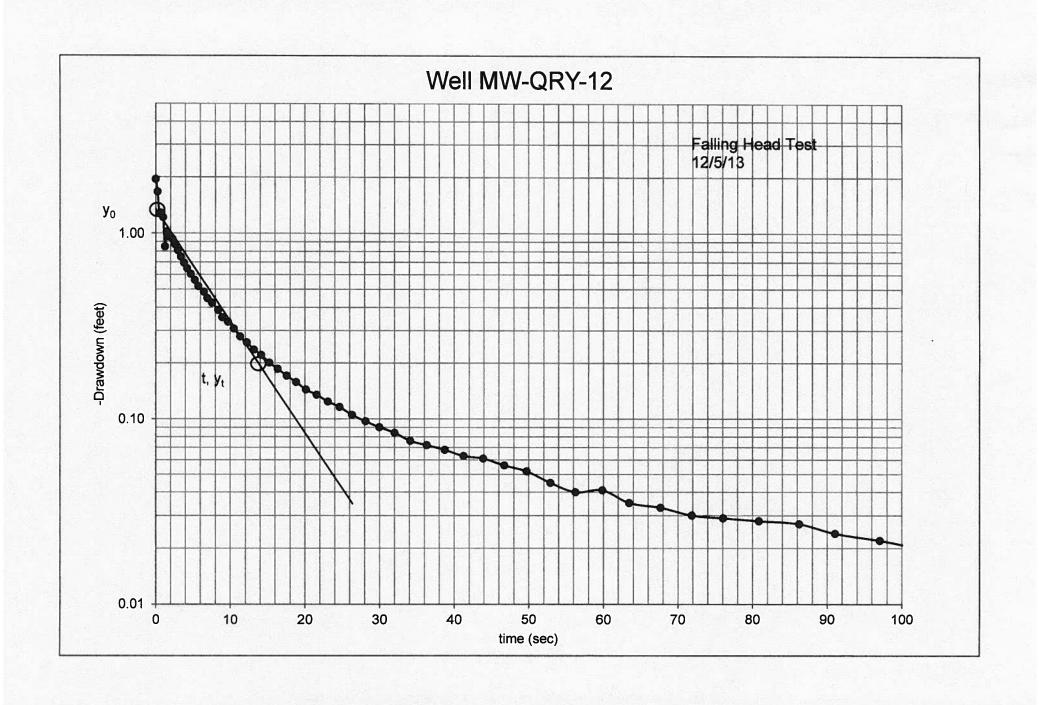
where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

0.5 3.2

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$



MW-QRY-12 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet	
12/5/2013 14:15	0	6.606	10.847	-0.011			
12/5/2013 14:15	0.251	6.604	10.869				
12/5/2013 14:15	0.501	6.605	10.882				
12/5/2013 14:15	0.751	6.604	10.89	-0.006			
12/5/2013 14:15	1.001	6.604	10.9	-0.007			
12/5/2013 14:15	1.251	6.604					
12/5/2013 14:15	1.501	6.604					
12/5/2013 14:15	1.751	6.604	10.912				
12/5/2013 14:15	2.001	6.603					
12/5/2013 14:15	2.251	6.603					
12/5/2013 14:15	2.501	6.605	10.924				
12/5/2013 14:15	2.751	6.719	10.923				
12/5/2013 14:15	3.001	6.876	10.926	-0.634			
12/5/2013 14:15	3.251	6.96	10.93				
12/5/2013 14:15	3.501	7.05	10.93				
12/5/2013 14:15	3.751	7.443	10.932	-1.943	0.00)	1.943 < h
12/5/2013 14:15	4.001						1.666
12/5/2013 14:15							1.272
12/5/2013 14:15							1.284
12/5/2013 14:15					1.00		1.215
12/5/2013 14:15							0.847
12/5/2013 14:15					1.50		1.016
12/5/2013 14:15				-0.955	1.75		0.955
12/5/2013 14:15				-0.955	2.00		0.955
12/5/2013 14:15	6.001	7.004		-0.93	2.25		0.930
12/5/2013 14:15				-0.869	2.61		0.869
12/5/2013 14:15	6.721			-0.808	2.97		0.808
12/5/2013 14:15	7.141			-0.747	3.39		0.747
12/5/2013 14:15	7.561	6.901			3.81		0.693
12/5/2013 14:15	7.981	6.881	10.917	-0.647	4.23		0.647
12/5/2013 14:15	8.461			-0.604	4.71		0.604
12/5/2013 14:15	9.001	6.844		-0.56	5.25		0.560
12/5/2013 14:15	9.48	6.826	10.924	-0.518	5.73	and an a	0.518
12/5/2013 14:15	10.213	6.81	10.905	-0.483	6.46		0.483
12/5/2013 14:15	10.681	6.795	10.905	-0.447	6.93		0.447

MW-QRY-12 Falling Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	-Drawdown feet
12/5/2013 14:15	11.281	6.784	10.904	-0.423	7.53	0.42
12/5/2013 14:15	12.132	6.769	10.895	-0.386		
12/5/2013 14:15	12.661	6.754	10.903	-0.353		
12/5/2013 14:15	13.44	6.746	10.895	-0.334		
12/5/2013 14:15	14.22	6.734	10.895			
12/5/2013 14:15	15.061	6.722	10.892	-0.278	11.31	
12/5/2013 14:15	15.96	6.713	10.89	-0.258	12.21	
12/5/2013 14:15	16.92	6.703	10.892	-0.236	13.17	
12/5/2013 14:15	17.88	6.697	10.888	-0.221	14.13	
12/5/2013 14:15	18.96	6.688	10.887	-0.201	15.21	
12/5/2013 14:15	20.101	6.682	10.886	-0.186	16.35	0.18
12/5/2013 14:15	21.301	6.675	10.883	-0.171	17.55	
12/5/2013 14:15	22.561	6.67	10.886	-0.158	18.81	
12/5/2013 14:15	23.88	6.664	10.878			
12/5/2013 14:15	25.321	6.66	10.879	-0.135		
12/5/2013 14:15	26.821	6.655	10.874	-0.124	23.07	0.12
12/5/2013 14:15	28.381	6.652	10.873	-0.116	24.63	0.11
12/5/2013 14:15	30.061	6.647	10.87	-0.105	26.31	0.10
12/5/2013 14:15	31.861	6.643	10.868	-0.097	28.11	0.09
12/5/2013 14:15	33.721	6.64	10.862	-0.09	29.97	0.09
12/5/2013 14:15	35.761	6.638	10.859	-0.084	32.01	0.08
12/5/2013 14:15	37.86	6.634	10.859	-0.076	34.11	0.07
12/5/2013 14:15	40.081	6.633	10.853	-0.072	36.33	0.07
12/5/2013 14:15	42.481	6.631	10.843	-0.068	38.73	0.06
12/5/2013 14:15	45.001	6.628	10.837	-0.063	41.25	0.06
12/5/2013 14:15	47.64	6.627	10.832	-0.061	43.89	0.06
12/5/2013 14:15	50.46	6.625	10.824	-0.056	46.71	0.05
12/5/2013 14:15	53.461	6.624	10.82	-0.052	49.71	0.05
12/5/2013 14:15	56.641	6.621	10.811	-0.045	52.89	0.04
12/5/2013 14:16	60	6.618	10.799	-0.04	56.25	0.04
12/5/2013 14:16	63.6	6.619	10.794	-0.041	59.85	0.04
12/5/2013 14:16	67.2	6.616	10.782	-0.035	63.45	0.03
12/5/2013 14:16	71.401	6.616	10.775	-0.033	67.65	
12/5/2013 14:16	75.6	6.614	10.765	-0.03	71.85	0.03
12/5/2013 14:16	79.801	6.614	10.757	-0.029	76.05	

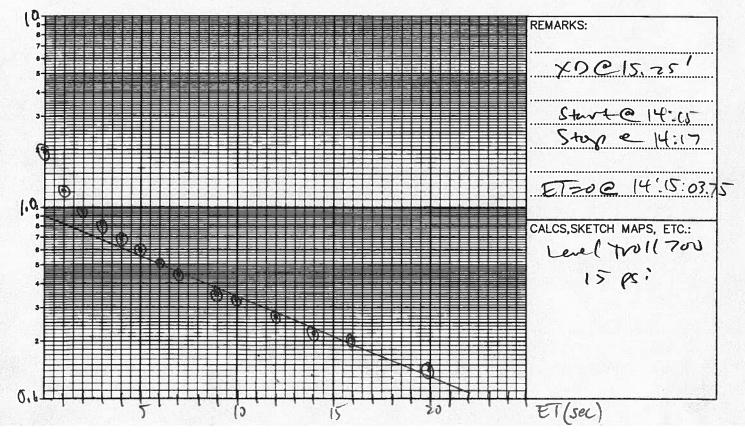
Quarry, NAS Brunswick, ME

MW-QRY-12 Falling Head Test

	Elapsed Time	SN#: 164036	SN#: 164036	SN#: 164036	Elapsed Time (Corr)	-Drawdown
Date and Time	Seconds	Pressure (PSI)	Temperature (C)	Level Depth To Water (ft)	seconds	feet
12/5/2013 14:16	84.601	6.613	10.745	-0.028	80.85	0.028
12/5/2013 14:16	90		10.733	0.020		
12/5/2013 14:16	94.801	6.612	10.725	-0.024	91.05	0.024
12/5/2013 14:16	100.8	6.611	10.712	-0.022	97.05	0.022
12/5/2013 14:16	106.801	6.61	10.702	-0.02	103.05	0.020
12/5/2013 14:16	112.8	6.61	10.688	-0.02	109.05	0.020
12/5/2013 14:16	119.4	6.612	10.678	-0.025	115.65	0.025
12/5/2013 14:17	126.6	6.607	10.665	-0.013	122.85	0.013
12/5/2013 14:17	134.4	6.608	10.652	-0.015	130.65	0.015
12/5/2013 14:17	142.2	6.608	10.636	-0.015	138.45	0.015



		1/2 (00001	2/001.11		TANK II	- maria	NO: MW-QRYIZ
	WELL DIAMET	ED. 2"	SCREEN II	ENOTU (NEDTU.	10.0	TES	ST NO.: FAILING
ų.	STATIC WATE	R LEVEL (Depti	h/Elevation):	2.8	ų ⁽	DA	TE:12/5/13
N.	TEST TYPE (I	Rising/Falling/C	Constant Head):	Fall	(in	CHECKED:	
8/89	METHOD OF I	INDUCING WATE	R LEVEL CHANG	e: Puc S	ار (٥٠١)	Ø x 5.1')	PAGE OF
65/90/10	REFERENCE F	T. FOR WL ME	AS. (Top of Cas	ing, Transduce	r, etc.):	TIPL	
T.dwg	ELAPSED TIME (min. or sec)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	WELL SCHEMATIC / WELL # 21/
ACAD: FORM_HYDCONTST.dwg	Ð		-1943	12		-0.278	BOREHOLE #
욁			-1,215	14		-0.221	3-4"
FORM	2		-0.955	16		-0.201	Depths (TOC)
ÇAD	5		-0.808	20		0.144	33
	4_		-0.693	25		-0.116	9.8
	5		-0.604	27		-0.(05	
8	7		-0.518	30		-0.090	
-	100	ENGLISH OF	-0.447				SCREET
+	8		-0,473				19.8
H	ام		-6.353				GRA
	11		-0.307				V Indicate SWL Depth on Drawing



TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

Project:

Quarry

NAS Brunswick, ME

Well Number

ber MW-QRY-12

Test Type
Test Date

Rising Head Calcs By: TSE 12/5/2013 Checked By: SJC

Well/Aquifer Information

Le/rw =

60.0

WATER TABLE WATER TABLE

Values from time-drawdown graph

y ₀ =	1.45	feet
y _t =	0.20	feet
t = 1	11.0	sec

Intermediate Calculations

For Lw < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}} \right]^{-1}$$

 $ln (R_e/r_w) = Use formula for Lw=H$

Dimensionless Parameters as Function of La/r,

(See page 2 for calcs)

For $L_{w=}H$ $\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln (L_{w}/r_{w})} + \frac{C}{L_{e}/r_{w}}\right]^{-1}$ $\ln (R_{e}/r_{w}) = 3.44$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 1.29E-02 \text{ feet / minute}$$

$$K = 1.86E+01 \text{ feet / day}$$

$$K = 6.55E-03 \text{ centimeters / second}$$



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-12

Test Type Test Date

Rising Head 12/5/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," Groundwater, v. 42, no. 5.

L= $r_w =$

10.00 feet 0.167 feet

from page 1

L/r_w=

60.0

log L/r_w=

1.778

Bouwer and Rice Coefficients

A=

3.5

where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B=

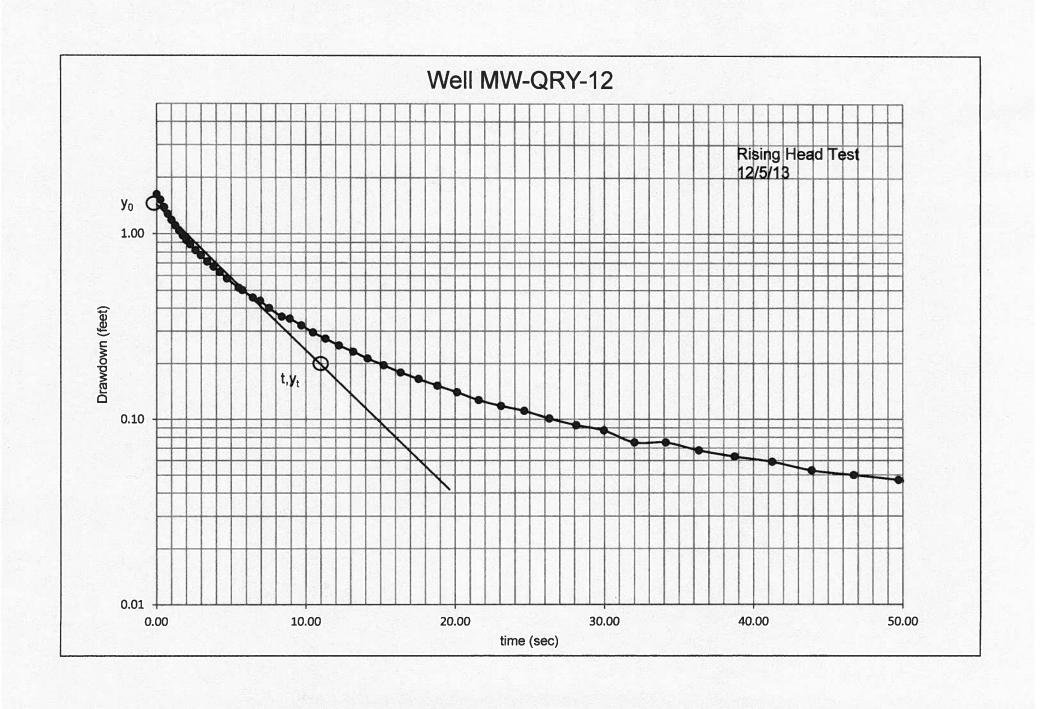
0.5

 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

3.2

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$



MW-QRY-12 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet	
12/5/2013 13:54	0	6.639	10.026	-0.016			
12/5/2013 13:54	0.251	6.637	10.048	-0.013			
12/5/2013 13:54	0.501	6.637	10.062	-0.012			
12/5/2013 13:54	0.751	6.639	10.071	-0.017			
12/5/2013 13:54	1.001	6.638	10.078	-0.014			
12/5/2013 13:54	1.251	6.638	10.083	-0.015			
12/5/2013 13:54	1.501	6.638	10.087	-0.014			
12/5/2013 13:54	1.751	6.638	10.091	-0.015			
12/5/2013 13:54	2.001	6.637	10.096	-0.013			
12/5/2013 13:54	2.251	6.638	10.101	-0.013			
12/5/2013 13:54	2.501	6.637	10.102				
12/5/2013 13:54	2.751	6.332	10.101	0.693			
12/5/2013 13:54	3.001	6.02	10.103	1.412			
12/5/2013 13:54	3.251	6.226	10.109				
12/5/2013 13:54	3.501	5.998	10.108	1.462			
12/5/2013 13:54	3.751	5.929	10.112				1.623 <
12/5/2013 13:54	4.001	5.975	10.112	1.517	0.25	5	1.517
12/5/2013 13:54	4.251	6.032			0.50		1.385
12/5/2013 13:54	4.501	6.08					1.274
12/5/2013 13:54	4.751	6.119					1.183
12/5/2013 13:54	5.001	6.152	10.116				1.107
12/5/2013 13:54	5.251	6.181	10.12				1.040
12/5/2013 13:54	5.501	6.208			1.75		0.979
12/5/2013 13:54	5.751	6.232	10.125	0.924	2.00		0.924
12/5/2013 13:54	6.001	6.251	10.121	0.879	2.25		0.879
12/5/2013 13:54	6.361	6.278	10.114	0.818	2.61		0.818
12/5/2013 13:54	6.721	6.299	10.109	0.769	2.97		0.769
12/5/2013 13:54	7.141	6.323	10.101	0.713	3.39		0.713
12/5/2013 13:54	7.561	6.342	10.102	0.669	3.81		0.669
12/5/2013 13:54	7.981	6.36	10.102		4.23		0.627
12/5/2013 13:54	8.461	6.381	10.098		4.71		0.578
12/5/2013 13:54	9.241	6.408	10.092		5.49		0.516
12/5/2013 13:54	9.481	6.415	10.106	0.501	5.73		0.501
12/5/2013 13:54	10.197	6.434	10.091	0.456	6.45		0.456
12/5/2013 13:54	10.681	6.442	10.096	0.438	6.93		0.438

MW-QRY-12 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 13:54	11.281	6.459	10.096	0.4	7.53	0.400
12/5/2013 13:54	12.133	6.476	10.09			
12/5/2013 13:54	12.66	6.48	10.098			
12/5/2013 13:54	13.44	6.492	10.095			
12/5/2013 13:54	14.22	6.504	10.096			
12/5/2013 13:54	15.061	6.513	10.097			
12/5/2013 13:54	15.96	6.523	10.101			
12/5/2013 13:54	16.92	6.531	10.102			
12/5/2013 13:54	17.88	6.54	10.104			
12/5/2013 13:54	18.961	6.547	10.107			
12/5/2013 13:54	20.101	6.554				
12/5/2013 13:54	21.301	6.56	10.115			
12/5/2013 13:54	22.561	6.566	10.12			
12/5/2013 13:54	23.88	6.571	10.125			
12/5/2013 13:54	25.321	6.577	10.128			
12/5/2013 13:54	26.821	6.581	10.135	0.118		
12/5/2013 13:54	28.381	6.584	10.142			
12/5/2013 13:54	30.061	6.588	10.15	0.101	26.31	
12/5/2013 13:54	31.861	6.591	10.156	0.093	28.11	
12/5/2013 13:54	33.72	6.594	10.162	0.087	29.97	
12/5/2013 13:54	35.761	6.599	10.17			
12/5/2013 13:54	37.86	6.599	10.175	0.075	34.11	
12/5/2013 13:54	40.081	6.602	10.185	0.068	36.33	
12/5/2013 13:54	42.481	6.604	10.191	0.063	38.73	
12/5/2013 13:54	45.001	6.606	10.2	0.059	41.25	0.059
12/5/2013 13:54	47.64	6.609	10.21	0.053	43.89	0.053
12/5/2013 13:54	50.46	6.61	10.219	0.05	46.71	0.050
12/5/2013 13:54	53.461	6.612	10.23	0.047	49.71	0.047
12/5/2013 13:54	56.641	6.613	10.242	0.043	52.89	0.043
12/5/2013 13:55	60	6.615	10.252	0.038	56.25	
12/5/2013 13:55	63.6	6.615	10.261	0.038	59.85	0.038
12/5/2013 13:55	67.2	6.617	10.275	0.034	63.45	
12/5/2013 13:55	71.4	6.618	10.289	0.032	67.65	0.032
12/5/2013 13:55	75.6	6.619	10.302	0.029	71.85	0.029
12/5/2013 13:55	79.801	6.621	10.318	0.025	76.05	0.025

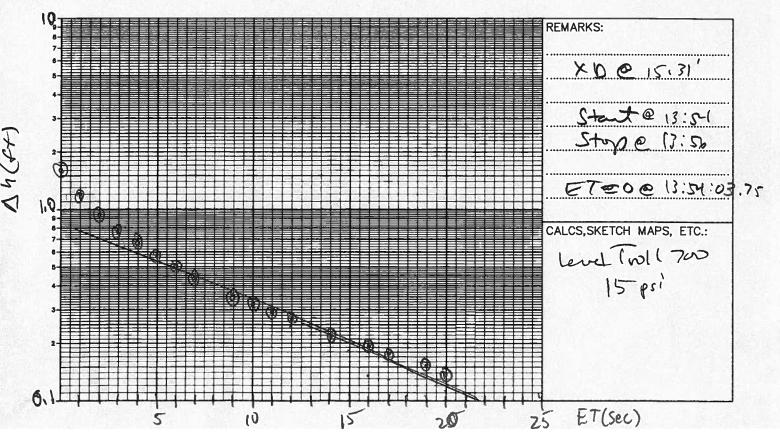
MW-QRY-12 Rising Head Test

Quarry, NAS Brunswick, ME

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/5/2013 13:55	84.6	6.621	10.331	0.024	80.85	0.024
12/5/2013 13:55	90.001	6.622	10.344	0.022	86.25	0.022
12/5/2013 13:55	94.801	6.623	10.358	0.02	91.05	0.020
12/5/2013 13:55	100.8	6.624	10.373	0.018	97.05	
12/5/2013 13:55	106.801	6.624	10.386	0.018	103.05	
12/5/2013 13:55	112.8	6.625	10.401	0.017	109.05	
12/5/2013 13:55	119.4	6.629	10.415	0.006		0.0
12/5/2013 13:56	126.6	6.621	10.429	0.024	122.85	
12/5/2013 13:56	134.4	6.625	10.444	0.016	130.65	
12/5/2013 13:56	142.2	6.625	10.461	0.015		0.010



# 1	PROJECT NAM	ME: QNOWN	1/NAS (CEOLOGIST.	h T.EVa	WELL/BORING	NO.: MW-QRY-12. ST NO.: RISING. TE: 12/5/12 PAGE OF
=	WELL DIAMET	ER: Q''	SCREEN L	ENGTH/DEPTH:	, 10.0	TES	12/5/12
IN	TEST TYPE (I	Rising/Falling/C	Constant Head):	Lis.	~ [\ (' \	CHECKED:	
65/90/10	METHOD OF I	PT. FOR WL ME	R LEVEL CHANG AS. (Top of Cas	ing, Transduce	r, etc.):	TOVE	PAGE\. OF .(
ST.dwg	ELAPSED TIME (min. of sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min. or sec.)	MEASURED WATER LEVEL (feet)	DRAWDOWN OR HEAD (ΔH) (feet)	WELL SCHEMATIC
ACAD: FORM_HYDCONTST.dwg	0		1.623	13		0.273	BOREHOLE # 44
D: FORM	2		0.924	14		0.213	Depths (TOC)
AC/	4		0.669	17		0,179	4 9.3
	6		0,501	20		0,140	Z - z -
			0.438	30		0.101	19. 3
	9		01350	60		0.038	19.7
t	11		0.295				✓ Indicate SWL Depth on Drawing



TE TETRA TECH

Bouwer & Rice Slug Test Analysis

(Bouwer, 1989)

WATER TABLE

Project:

Quarry

NAS Brunswick, ME

Well Number

well number

Test Type Test Date

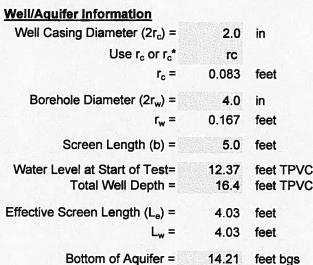
> feet MSL) feet MSL) feet

MW-QRY-10

Rising Head 12/4/2013

Calcs By: TSE Checked By: SJC

 $2r_c$



L _w =	4.03
Bottom of Aquifer =	14.21
(Ground Surface Elevation =	94.15
(TPVC Elevation =	96.34
H =	4.03
$L_{e}/r_{w} =$	24.2

Values from time-drawdown graph

y ₀ =	0.29	feet
y _t =	0.02	feet
t =	800.0	sec

Dimensionless Parameters as Function of La/rw

(See page 2 for calcs)

Intermediate Calculations

For Lw < H

$$\ln \frac{R_{e}}{r_{w}} = \left[\frac{1.1}{\ln(L_{w}/r_{w})} + \frac{A + B \ln((H - L_{w})/r_{w})}{L_{e}/r_{w}} \right]^{1}$$

In (R_e/r_w) = Use formula for Lw=H

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (L_w / r_w)} + \frac{C}{L_e / r_w} \right]^{-1}$$

$$\ln (R_e / r_w) = 2.42$$

$$K = \frac{r_c^2 \times \ln(R_e/r_w)}{2L_e} \times \frac{1}{t} \times \ln \frac{y_o}{y_t}$$

$$K = 4.27\text{E-04 feet / minute}$$

$$K = 6.14\text{E-01 feet / day}$$

$$K = 2.17\text{E-04 centimeters / second}$$



Quarry

NAS Brunswick, ME

Well Number

MW-QRY-10

Test Type
Test Date

Rising Head 12/4/2013

Equations from S-Y. Yang and H-D. Yeh, 2004, "A Simple Approach Using Bower Rice's Method for Slug Test Data Anlaysis," *Groundwater*, v. 42, no. 5.

L= r_w= 4.03 feet 0.167 feet

from page 1

 $L/r_w =$

24.2

log L/r_w=

1.383

1.6

Bouwer and Rice Coefficients

A= 2.

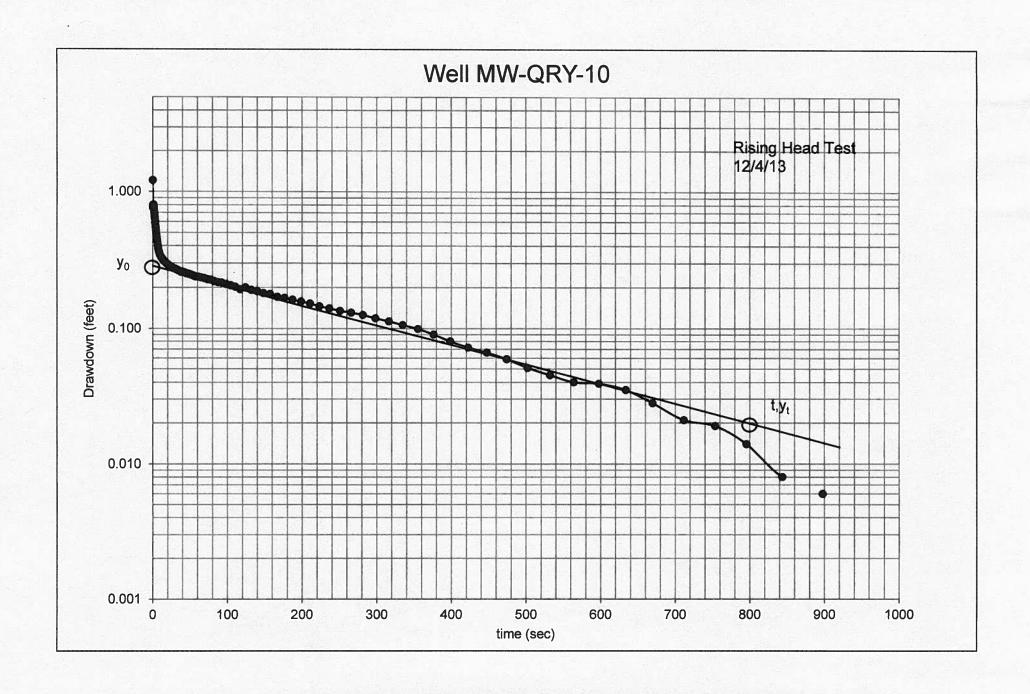
2.3 where, $A(x) = 1.353 + 2.157x - 4.027x^2 + 2.777x^3 - 0.460x^4$

B= 0.3

 $B(x) = -0.401 + 2.619x - 3.267x^2 + 1.548x^3 - 0.210x^4$

C=

 $C(x) = -1.605 + 9.496x - 12.617x^2 + 6.528x^3 - 0.986x^4$



MW-QRY-10 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 13:48	0	1.595	9.82	-0.007		
12/4/2013 13:48	0.251	1.595	9.845	-0.006		
12/4/2013 13:48	0.501	1.595	9.859	-0.007		
12/4/2013 13:48	0.751	1.594	9.868	-0.004		
12/4/2013 13:48	1.001	1.595	9.874	-0.007		
12/4/2013 13:48	1.251	1.595	9.881	-0.006		
12/4/2013 13:48	1.501	1.595	9.889	-0.006		
12/4/2013 13:48	1.751	1.594	9.89			
12/4/2013 13:48	2.23	1.674	9.874	-0.188		
12/4/2013 13:48	2.45	1.068	9.888	1.21	0.00	1.210 <
12/4/2013 13:48	2.67	1.263				
12/4/2013 13:48						
12/4/2013 13:48						
12/4/2013 13:48						
12/4/2013 13:48						
12/4/2013 13:48						
12/4/2013 13:48						
12/4/2013 13:48	4.467					
12/4/2013 13:48	4.687	1.296				
12/4/2013 13:48						
12/4/2013 13:48						
12/4/2013 13:48	5.345	1.32	9.923	0.628	2.90	0.628
12/4/2013 13:48	5.564	1.336	9.925	0.591	3.11	0.591
12/4/2013 13:48	5.783	1.333	9.929	0.599	3.33	0.599
12/4/2013 13:48	6.003	1.349	9.927	0.562	3.55	0.562
12/4/2013 13:48	6.361	1.357	9.938	0.543	3.91	0.543
12/4/2013 13:48	6.721	1.368	9.921	0.519	4.27	0.519
12/4/2013 13:48	7.141	1.379	9.908	0.493	4.69	0.493
12/4/2013 13:48	7.561	1.389	9.903	0.469	5.11	0.469
12/4/2013 13:48	7.981	1.398	9.9	0.448	5.53	0.448
12/4/2013 13:48	8.461	1.407	9.894	0.427	6.01	0.427
12/4/2013 13:48	9.001	1.417	9.888	0.405	6.55	0.405
12/4/2013 13:48	9.481	1.424	9.888	0.389	7.03	0.389
12/4/2013 13:48	10.081	1.43	9.882	0.375	7.63	0.375
12/4/2013 13:48	10.681	1.434	9.881	0.364	8.23	0.364

MW-QRY-10 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 13:48	11.281	1.439	9.877	0.354	8.83	0.35
12/4/2013 13:48	11.941	1.443	9.877	0.344		
12/4/2013 13:48	12.661	1.446	9.874	0.338	10.21	
12/4/2013 13:48	13.441	1.448	9.87	0.332	10.99	0.33
12/4/2013 13:48	14.22	1.45	9.873	0.328	11.77	0.32
12/4/2013 13:48	15.061	1.453	9.872	0.321	12.61	0.32
12/4/2013 13:48	15.96	1.455	9.869	0.318	13.51	0.31
12/4/2013 13:48	16.92	1.457	9.866	0.311	14.47	0.31
12/4/2013 13:48	17.88	1.459	9.867	0.308	15.43	0.30
12/4/2013 13:48	18.96	1.46	9.866	0.304	16.51	0.30
12/4/2013 13:48	20.101	1.462	9.863	0.301	17.65	0.30
12/4/2013 13:48	21.301	1.464	9.863	0.296	18.85	0.29
12/4/2013 13:48	22.561	1.465	9.86	0.293	20.11	0.29
12/4/2013 13:48	23.881	1.467	9.861	0.289	21.43	0.28
12/4/2013 13:48	25.321	1.468	9.859	0.286	22.87	0.28
12/4/2013 13:48	26.835	1.47	9.858	0.283	24.39	0.28
12/4/2013 13:48	28.38	1.471	9.858	0.279	25.93	0.27
12/4/2013 13:48	30.061	1.473	9.856	0.275	27.61	0.27
12/4/2013 13:48	31.861	1.474	9.857	0.273	29.41	0.27
12/4/2013 13:48	33.721	1.475	9.855	0.27	31.27	0.27
12/4/2013 13:48	35.761	1.476	9.854	0.267	33.31	0.26
12/4/2013 13:48	37.861	1.478	9.857	0.263	35.41	0.26
12/4/2013 13:48	40.08	1.48	9.853	0.259	37.63	0.25
12/4/2013 13:48	42.481	1.48	9.853	0.259	40.03	0.25
12/4/2013 13:48	45.001	1.481	9.851	0.256	42.55	0.25
12/4/2013 13:48	47.641	1.483	9.851	0.252	45.19	0.25
12/4/2013 13:48	50.461	1.484	9.85	0.25	48.01	0.25
12/4/2013 13:48	53.46	1.485	9.848	0.247	51.01	0.24
12/4/2013 13:48	56.641	1.487	9.848	0.243	54.19	0.24
12/4/2013 13:49	60.001	1.488	9.847	0.239	57.55	0.23
12/4/2013 13:49	63.601	1.489	9.844	0.238	61.15	0.23
12/4/2013 13:49	67.2	1.49	9.843	0.236	64.75	0.23
12/4/2013 13:49			9.848	0.233	68.95	0.23
12/4/2013 13:49			9.842	0.229	73.15	0.22
12/4/2013 13:49	79.8	1.494	9.84	0.227	77.35	0.22

MW-QRY-10 Rising Head Test

Date and Time	Seconds		SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 13:49		84.601	1.496	9.842	0.222	82.15	0.22
12/4/2013 13:49		90	1.498	9.839	0.218	87.55	
12/4/2013 13:49		94.8	1.499	9.838	0.216	92.35	
12/4/2013 13:49	1	100.801	1.501	9.838	0.211	98.35	
12/4/2013 13:49		106.8	1.502	9.835	0.207	104.35	
12/4/2013 13:49	Langing 1	112.801	1.505	9.834	0.202	110.35	
12/4/2013 13:49		119.4	1.508	9.833	0.194	116.95	
12/4/2013 13:50	1	126.601	1.506	9.832	0.2	124.15	
12/4/2013 13:50		134.4	1.509	9.831	0.192	131.95	
12/4/2013 13:50		142.2	1.511	9.827			
12/4/2013 13:50	. = 1	150.601	1.513	9.826	0.182		
12/4/2013 13:50		159.6	1.515	9.823	0.179		
12/4/2013 13:50		169.2	1.518	9.821	0.171		
12/4/2013 13:50		178.8	1.519	9.821	0.168	176.35	
12/4/2013 13:51		189.6	1.521	9.819	0.163	187.15	0.16
12/4/2013 13:51	2	201.001	1.524	9.818	0.158	198.55	0.15
12/4/2013 13:51	2	213.001	1.526	9.818	0.153		
12/4/2013 13:51		225.6	1.529	9.815	0.146	223.15	
12/4/2013 13:51	2	238.801	1.531	9.811	0.141	236.35	0.14
12/4/2013 13:52		253.2	1.534	9.811	0.135	250.75	0.13
12/4/2013 13:52		268.2	1.535	9.808	0.131	265.75	0.13
12/4/2013 13:52		283.8	1.538	9.807	0.126	281.35	0.12
12/4/2013 13:53		300.6	1.541	9.803	0.119	298.15	0.11
12/4/2013 13:53		318.6	1.543	9.804	0.113	316.15	0.11
12/4/2013 13:53		337.2	1.546	9.799	0.106	334.75	0.10
12/4/2013 13:53		357.6	1.549	9.796	0.099	355.15	0.09
12/4/2013 13:54		378.6	1.553	9.794	0.09	376.15	0.09
12/4/2013 13:54		400.8	1.558	9.794	0.08	398.35	0.08
12/4/2013 13:55		424.8	1.561	9.794	0.072	422.35	0.07
12/4/2013 13:55	4	50.001	1.564	9.791	0.066	447.55	0.06
12/4/2013 13:55		476.4	1.567	9.789	0.059	473.95	0.05
12/4/2013 13:56		504.6	1.57	9.785	0.051	502.15	0.05
12/4/2013 13:56		534.6	1.573	9.785	0.045	532.15	0.04
12/4/2013 13:57		566.4	1.575	9.783	0.04	563.95	0.04
12/4/2013 13:58		600	1.575	9.781	0.039	597.55	0.03

Quarry, NAS Brunswick, ME

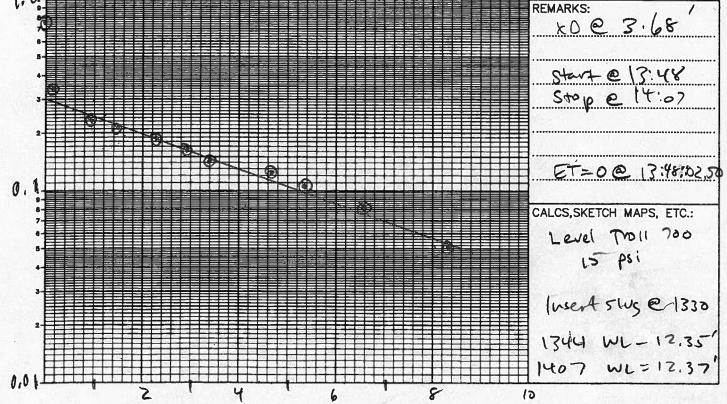
MW-QRY-10 Rising Head Test

Date and Time	Elapsed Time Seconds	SN#: 164036 Pressure (PSI)	SN#: 164036 Temperature (C)	SN#: 164036 Level Depth To Water (ft)	Elapsed Time (Corr) seconds	Drawdown feet
12/4/2013 13:58	6:	36 1.57	7 9.778	0.035	633.55	0.035
12/4/2013 13:59	6	72 1.5	9.78	0.028	669.55	0.028
12/4/2013 13:59	7:	14 1.58	9.777	0.021	711.55	0.021
12/4/2013 14:00	7!	1.58	9.777	0.019	753.55	0.019
12/4/2013 14:01	7:	98 1.58	9.775	0.014	795.55	0.014
12/4/2013 14:02	84	46 1.589	9.778	0.008	843.55	0.008
12/4/2013 14:03	90	00 1.589	9.775	0.006	897.55	0.006
12/4/2013 14:03	94	48 1.59	9.775	0	945.55	0.000
12/4/2013 14:04	100	08 1.59	9.776	0.002	1005.55	0.002
12/4/2013 14:05	100	58 1.59	9.772	-0.001	1065.55	-0.001
12/4/2013 14:06	113	28 1.59	9.775	-0.007	1125.55	-0.007



HYDRAULIC CONDUCTIVITY TESTING DATA SHEET

	PROJECT NO.	. 1126-006	12 /11520 506	GEOLOGIST:	T. E.	JANS	MW-QRY- ST NO.:
	WELL DIAMET	ER: 2"	SCREEN L	ENGTH/DEPTH:	6.0	TE	ST NO RIGIA
	STATIC WATE	R LEVEL (Depti	h/Elevation):	12.3	> TPVC	DA	TE: 12/4/13
z	TEST TYPE (Rising/Falling/C	constant Head):	Ris	ing	CHECKED:	PAGE OF
66/	METHOD OF	INDUCING WATE	R LEVEL CHANG	SE: PVC S	lus (0,1'0)	x 2.36)	PAGE OF
92/98	REFERENCE F	T. FOR WL ME	AS. (Top of Cas	ing, Transduce	r, etc.):	PVC	
2	ELAPSED TIME (mlh.) or sec.)	MEASURED WATER LEVEL	DRAWDOWN OR HEAD (ΔΗ) (feet)	ELAPSED TIME (min) or sec.)	MEASURED WATER LEVEL	DRAWDOWN OR HEAD (ΔH) (feet)	WELL SCHEMATIC
131.d		(feet)	- Variety Colonial Value	0	(feet)	(feet) O1 (46	WELL 0 -
	0.00		1.210	3.72			BOREHOLE
CAD: FORM_HYDCONTST	0.025		0.784	4.68		0,126	
<u>.</u>	0.037		0.718	5.68		0.(06	Depths (To
§ -	2005		6.628	6.43		0.080	9.4
ŀ	0117		0.344	8.37		0.051	11,4
-	0.52		0,200	11.17		0,028	
-	6167		0,259				
1	0.97		0,239				
L	1, 23		0,26				16.4
	1.63	11 11 11 12 12 12 12 12 12 12 12 12 12 1	0,202				16.4
9			0.188				✓ Indicate SWL
	2.93		0.168				Depth on Drawing



A-6 GROUNDWATER LEVEL MEASUREMENT SHEETS



Tetra Tech, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name:		Former NAS	B - Quarry Remedia	l Inv.	Project No.:	CTO WE09/	112G02063	
Location:		Brunswick	, Maine		Personnel:	B. Geringer	/ J.Traut	
Weather Condition	s:	Cloudy	70		_ Measuring Dev	ice: Soliast	Water lem	1 Indicator
Tidally Influenced		Yes	No _X		Remarks:	0.25 6	Frain Past	a4 hours
Well or Piezometer Number	Date	Time (hrs)	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)* MP=TOR	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
MW-QFY-OIA	8/28/12	1050	113,07	20.70	Dry	NIA	NIA	P2D=0.0
MW-QRY-OIB		1052	113.03	29.79	25.23		87.80	PID=0.0
MW-QRE-02		1057	105.68	24.37	18.13	V-F × 1	87.55	PID=0.0
MW-QRY-03		1030	95.31	12.92	9.25		86.06	PSO=0.2
MW-QRY-04		1040	97.25	18,94	4.28		87.97	12020,0
SG-GRY-01		1042	90.96	AIA	0.56		88.52	
SG-QRY-02	V	1036	88.29	1	No water	V	NIA	No Water
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Tetra Tech, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: Location:		Former NAS	B - Quarry Area Ri		Project No.:	112G02063 /	0000.2400	
		Brunswick		8 1 2 2		B. Geringer		
Weather Conditions			Windy 40		Measuring Dev			Marie Control
Tidally Influenced:	liest.	Yes	No _X_		Remarks:	Showers 6	eaglier in i	the Morales
Well or Piezometer Number	Date	Time (hrs)	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)* MP=TOR	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments
MH-QRY-OLA	10/12/12	1109			Dry			
" " -01B	" "	1110		5	25.22			-
-02		1114		The state of the s	17.25			
-03		1052			9.22'			
V-04		1102			8.48'			
My-02436		+						
SG-624-01		1103			0.35			
., 02		1055			0.2'			
-03	V	1025			0.7'			
* * *								
V								
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Fig. 1. Supplies				Jel				
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All measurements to the nearest 0.01	foot				- 100 19 - 100 100 100 100			

E TETRA TECH

GROUNDWATER LEVEL MEASUREMENT SHEET

Joane Warren

Project Nam Location: Weather Cor		Quarry Brunsw	ick ME	01(400)	Project No.: (1260 2063 / 00645 Personnel: T. E unn 5 Measuring Device: Herm Shinny Dipper						
Tidally Influe	enced:	100000000000000000000000000000000000000	No_X		Remarks:						
Well or Plezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments			
MW-QRY-03	10/28/3	0450	95131	12.85	8.72		86.59	TPUC			
-02		1000	105,68	24.29	16.87	~	88.81				
-018		1003	113.03	29.69	22,9,57		90.08				
-0/A		1007	113.07	19,91	Dry			Dry			
40-	U	10 15	97.25	18.83	77.67	1	89.58				
SG-QRY-01	10/28/13	1205	90.96		1.75 ?	+	89.71	From Granding			
8-Q402		1215	88.29*	-	<0.0	oding	(85.29	Standing was			
sg-anyes	V	1655	89.43*		1.60)	avye	86.03	9			
			*Ref P	+ C 3	feet (top	uf govs	د) ا				
					Service Advisor						
			1 2 00								
	SA WILLIAM					A Desirement					
	V 113)							



GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name Location: Weather Cond Tidally Influe	ditions:			- 405	Project No.: 1/2Go 2063 /00645 Personnel: T. Evans Measuring Device: 50/12st Model (0) Remarks: TPIC					
Well or Plezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments		
MW-QRY-06	11/2/13	0900	(2) 2020 2020 2020 2020 2020 2020	28.68	20.56					
NW-9RY-03		0910		13.20	8.81					
SG-QRY-02		0915			<0.00			Standing Hed but below M		
MW-QRY-12		0920		19,78	4,28	-	-			
mw-gry-05		0931		21.33	8.17			JC 18		
MW-QRI-OIA		0940		20.98	Day to !	ottom				
MW-dry-01	1000/4	0943		80.08	23.31					
MW- GRY-02		0945		24.66	16.87					
nw-924-04		0952		19.20	7,80					
MW-QRY-10		1000		16.43	12.56					
Mw-QRY-11		(015		12.98	9,93					
SG-QRY-01		1215	4.5		1,624			* Drect reading		
5G-QR4-03	Ý	1220			1.60 *	5	- J	from of marker		
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Tetra Tech, Inc.

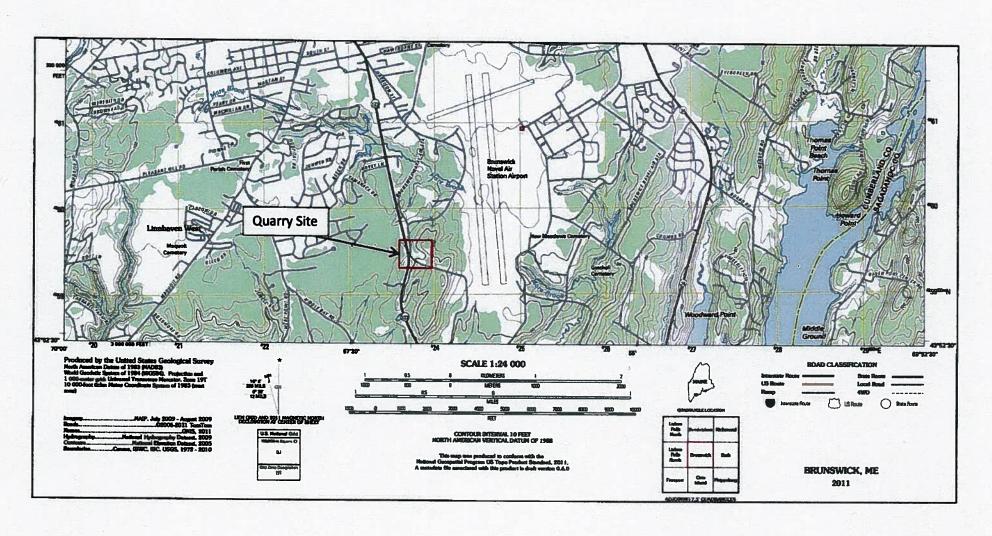
GROUNDWATER LEVEL MEASUREMENT SHEET

Location:			Brunswick	, Maine		Project No.: Personnel:	### C 10 DE04 / 112 G020 G3					
Weather Conditions						Measuring Dev	ice:					
Tidally Influenced:		distant	Yes	No _ X		Remarks:						
Well or Piezometer Number	Date		Time (hrs)	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)* MP=TOR	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments			
MW-QRY-OLA	12/2/	13	1315			18.18			PID= 0,0			
1- " - OIB	1		1313		20	18.13			P20=00			
-06			1318			17.58			P10=0.0			
-02			1321			15.62		7	P10=0.0			
-67		6	1326		7	3,52			PD= 0.0			
-08			1332		6	4.96			PID = 0.0			
-09			1340		<u> </u>	9.33			PID=0.0			
MW-56-						990						
56-QRY-03	L.V.		1342			0.91			Sings of Fine			
MW-GRY-11			1348			9.83		w	PID=00			
MW- QRY-10			1351			12.53			P10 = 0.0			
" -17			1357			2.81			PID=0.0			
V -04	li		1301			6.11			PID=0.0			
SG-987-01			1303			2.89			any of on			
MW-987- 05			1300			6.43	4		PID = 0.0			
03			1312			8.07			P3D = 0.1			
SG-027-02	V		1314			0.09						
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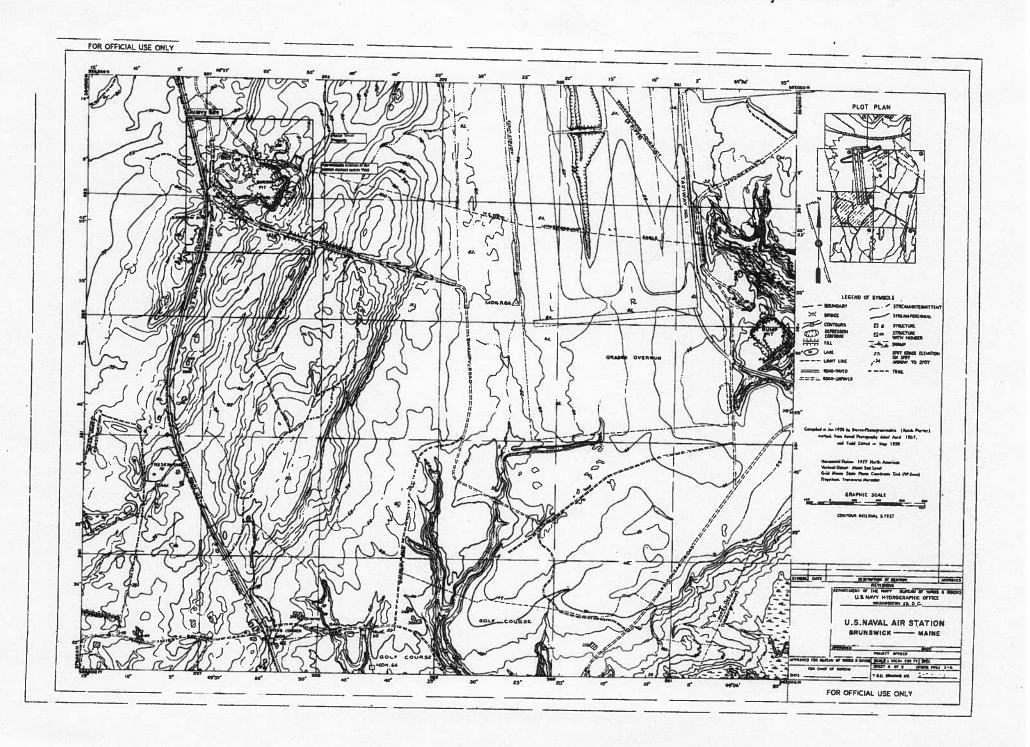
TOPOGRAPHIC MAP 2011 – BRUNSWICK QUADRANGLE

Appendix A-5

Topographic Map – Brunswick Quadrangle

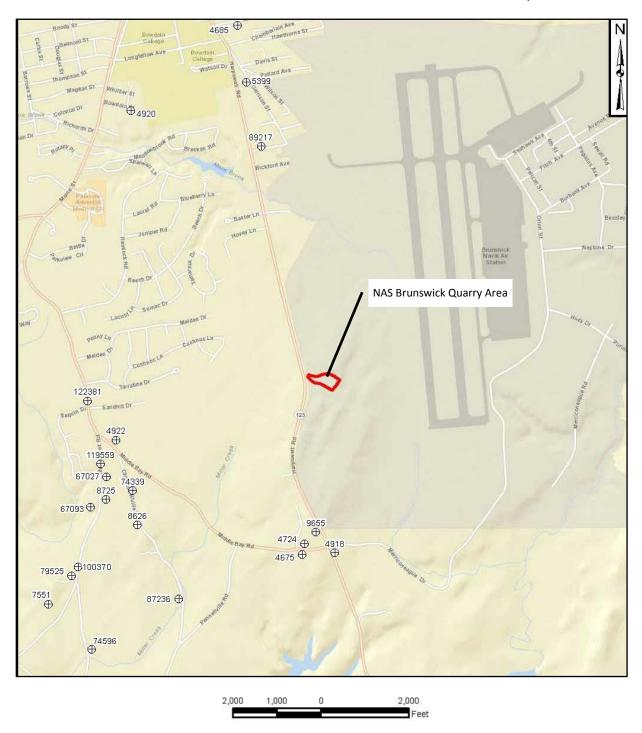


1958 NASB TOPOGRAPHIC MAP **A-8**



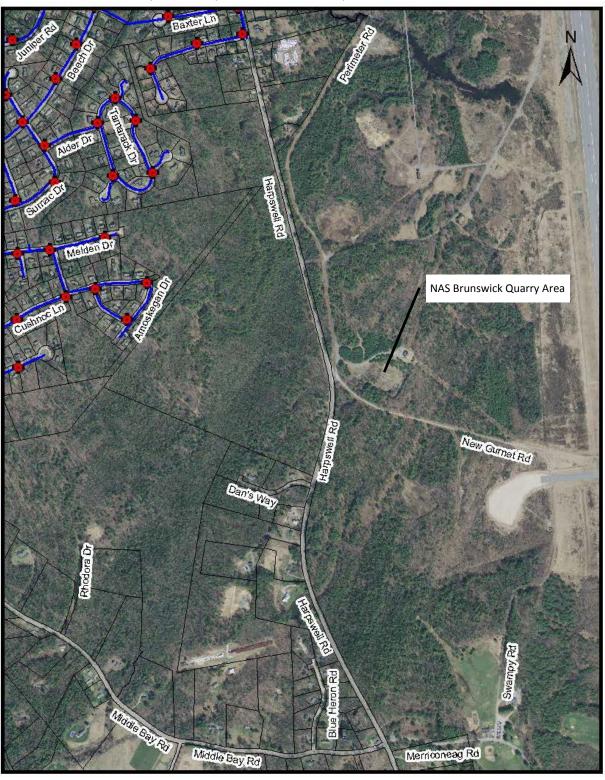
PUBLIC AND RESIDENTIAL WELLS NEARBY QUARRY

Location of Residential Wells Near the Former NAS Brunswick Quarry



Maine Geological Survey, 2013. Maine Geological Survey Water Well Shapefile, February. Downloaded 9/4/2013. www.maine.gove/doc/nrimc/mgs/pubs/digital/well.htm

Location of the Public Water Supply Near the Former NAS Brunswick Quarry provided by The Brunswick & Topsham Water District



APPENDIX B ANALYTICAL RESULTS AND SURVEY DATA

B-1 CHAIN-OF-CUSTODIES



600 Technology Way Scarborough, ME 04074 Tel: (207) 874-2400 Fax: (207) 775-4029

CHAIN of CUSTODY

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	12 DGGW RB01-082712	/1515	AQ	14	\times	X	X	\times	X	×	X			No.
	1206GW001-0812	/1555	GW	14	\times	X	X	X	X	X	×			
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CHAIN of CUSTODY

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600 Technology Way Scarborough, ME 04074 Tel: (207) 874-2400

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

C	Tetra Tech			Beio	in Ger	inger		Phone #		8406	F	ax#	Unio	
A	ddress 250 Andover S	yt. # 200	City	Wilmi	nyton	3.		State	MA	0.706	Zip Co	de Oli	227	845
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600 Technology Way Scarborougly, ME 04074 Tel: (207) 874-2400 Fax: (207) 775-4029

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Katahdin Katahdin Scarborough, ME 04074 Tel: (207) 874-2400 Fax: (207) 775-4029

CHAIN of CUSTODY

PLEASE BEAR DOWN AND PRINT LEGIBLY IN PEN

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Ad	dress 661 ANC	iensen D	City								Zip Cod	e 15	-22	0
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Page ____ of __

С	lient T. 40 T.	. /	Client TETRA TECH Contact LINDA KLINK Phone # (4/12) 921-7090 Fax.# (4/12) 921-401 Address 661 ANDERSEN DR#7 City PITSRURGH State PA Zip Code 15220												
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*	QRY D9-GW04-1213	1 / 1420	V	17	3	2	2	2	2		2	2	1		
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	QRYD9-GWDUP01-124	513 / 10000	1	17	3	12	2	2	2	demanda.	2	2			
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LOCATION	MW-QRY-01A	MW-QR	Y-01B	MW-QF	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
EPH MADEP (ug/L)				•				
C11-C22 AROMATICS	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U
C11-C22 AROMATICS-UNADJ	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U
C19-C36 ALIPHATICS	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U
C9-C18 ALIPHATICS	71 U	71 U	71 U	71 U	71 U	71 U	71 U	71 U
Explosives (ug/L)								
1,3,5-TRINITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
1,3-DINITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2,4,6-TRINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2,4-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2-AMINO-4,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
3,5-DINITROANILINE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
3-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
4-AMINO-2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
4-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
HMX	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
NITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
NITROGLYCERIN	2 U	2 UJ	2 U	2 UJ	2 U	2 UJ	2 U	2 UJ
PETN	2 U	2 U	2 U	2 U	2 U	2 U	2 U	2 U
RDX	0.2 J	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
TETRYL	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Inorganics (ug/L)	-	· · · · · · · · · · · · · · · · · · ·		-	-	-	-	
ALUMINUM	99.6 J	40 U	40 U	40 U	44.3 U	60.4 J	59.4	58.4 J
ANTIMONY	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ARSENIC	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
BARIUM	19.9	32.1	48	48.7	53.8	59.8	59.15	58.5
BERYLLIUM	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CADMIUM	0.2 U	0.2 U	0.2 U	0.04 J	0.2 U	0.13 J	0.125	0.12 J
CALCIUM	26900	31700	26200	21500	14200	28600	28350	28100
CHROMIUM	4 U	4 U	4 U	4 U	4 U	4 U	4 U	4 U
COBALT	0.1 J	0.3 UJ	0.1 J	0.1 J	0.66 J	49.6	49.25	48.9

LOCATION	MW-QRY-01A	MW-QR'	Y-01B	MW-Q	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
COPPER	2 U	0.94 J	2 U	2.1 J	6.4 U	5	4.1	3.2
IRON	131	90.4 J	53.4 J	40.3 J	28.4 J	2540	2590	2640
LEAD	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MAGNESIUM	2420	1740	1740	2110	1200	6400	6355	6310
MANGANESE	5.4	36.8	2.4	54.8	8.3	4830	4785	4740
MERCURY	0.1 U	0.1 U	0.1 UJ	0.1 U	0.1 UJ	0.1 U	0.1 U	0.1 U
NICKEL	1.2 U	1.2 U	1.2 U	1.2 U	1.2 U	11.5	11.3	11.1
POTASSIUM	3390	5660	3250	2050	3260	3120	3130	3140
SELENIUM	3 U	3 U	3 U	3 U	3 U	3 U	3 U	3 U
SILVER	0.08 J	0.4 U	0.09 J	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
SODIUM	4570	3950	3430	5270	7040	6380	6315	6250
THALLIUM	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
VANADIUM	4 U	1.2 J	4 U	0.93 J	4 U	4 U	0.98 J	0.98 J
ZINC	8 U	8 U	8 U	8 U	8 U	4.9 J	4.9 J	8 U
Misc. Parameters (ug/L)								
PERCHLORATE	0.133 J	0.055 J	0.1 U	0.12 J	0.2 J	0.12 UJ	0.12 U	0.12 UJ
PCBS (ug/L)								
AROCLOR-1016	0.048 UJ	0.05 UJ	0.047 U	0.047 UJ	0.048 U	0.047 UJ	0.047 U	0.047 UJ
AROCLOR-1221	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
AROCLOR-1232	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
AROCLOR-1242	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
AROCLOR-1248	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
AROCLOR-1254	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
AROCLOR-1260	0.048 UJ	0.05 UJ	0.047 U	0.047 UJ	0.048 U	0.047 UJ	0.047 U	0.047 UJ
AROCLOR-1262	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
AROCLOR-1268	0.048 U	0.05 U	0.047 U	0.047 U	0.048 U	0.047 UJ	0.047 U	0.047 U
TOTAL AROCLOR	NA	0 U	NA	0 U	NA	0 U	0 U	0 U
TOTAL AROCLOR HALFND	NA	0.225	NA	0.2115	NA	0.2115	0.2115	0.2115
Pesticides (ug/L)								
4,4'-DDD	0.0097 U	0.01 UJ	0.0094 U	0.0094 U	0.0097 U	0.0094 U	0.0094 U	0.0094 U
4,4'-DDE	0.0097 UJ	0.01 UJ	0.0094 U	0.0094 UJ	0.0097 U	0.0094 UJ	0.0094 U	0.0094 UJ
4,4'-DDT	0.0097 U	0.01 UJ	0.0094 U	0.0094 U	0.0097 U	0.0094 U	0.0094 U	0.0094 U
ALDRIN	0.0048 UJ	0.005 UJ	0.0047 U	0.0047 UJ	0.0048 U	0.0047 UJ	0.0047 U	0.0047 UJ

LOCATION	MW-QRY-01A	MW-QR'	Y-01B	MW-QI	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
ALPHA-BHC	0.0048 UJ	0.005 UJ	0.0047 U	0.0047 UJ	0.0048 U	0.0047 UJ	0.0047 U	0.0047 UJ
ALPHA-CHLORDANE	0.0048 UJ	0.0061 J	0.0047 U	0.0047 U	0.0048 U	0.0047 U	0.0047 U	0.0047 U
BETA-BHC	0.0048 U	0.005 UJ	0.0047 U	0.0047 UJ	0.0048 U	0.0047 UJ	0.0047 U	0.0047 UJ
DELTA-BHC	0.0048 U	0.005 UJ	0.0047 U	0.0047 U	0.0048 U	0.0047 U	0.0047 U	0.0047 U
DIELDRIN	0.0097 UJ	0.01 UJ	0.0094 U	0.0094 UJ	0.0097 U	0.0094 UJ	0.0094 U	0.0094 UJ
ENDOSULFAN I	0.0048 UJ	0.005 UJ	0.0047 U	0.0047 U	0.0048 U	0.0047 U	0.0047 U	0.0047 U
ENDOSULFAN II	0.0097 U	0.01 UJ	0.0094 U	0.002 J	0.0097 U	0.0094 UJ	0.0094 U	0.0094 UJ
ENDOSULFAN SULFATE	0.0097 U	0.01 UJ	0.0094 U	0.0094 U	0.0097 U	0.0094 U	0.0094 U	0.0094 U
ENDRIN	0.0097 UJ	0.01 UJ	0.0094 U	0.0094 UJ	0.0097 U	0.0094 UJ	0.0094 U	0.0094 UJ
ENDRIN ALDEHYDE	0.0097 U	0.01 UJ	0.0094 U	0.0094 U	0.0097 U	0.0094 U	0.0094 U	0.0094 U
ENDRIN KETONE	0.0097 UJ	0.01 UJ	0.0094 UJ	0.0094 UJ	0.0097 UJ	0.0094 UJ	0.0094 U	0.0094 UJ
GAMMA-BHC (LINDANE)	0.0048 U	0.005 UJ	0.0047 U	0.0047 UJ	0.0048 U	0.0047 UJ	0.0047 U	0.0047 UJ
GAMMA-CHLORDANE	0.0048 UJ	0.0073 J	0.0047 U	0.0047 UJ	0.0048 U	0.0047 UJ	0.0047 U	0.0047 UJ
HEPTACHLOR	0.0048 U	0.005 UJ	0.0047 U	0.0047 U	0.0048 U	0.0047 U	0.0047 U	0.0047 U
HEPTACHLOR EPOXIDE	0.0048 UJ	0.005 UJ	0.0047 U	0.0047 U	0.0048 U	0.0027 J	0.0027 J	0.0047 U
METHOXYCHLOR	0.048 U	0.05 UJ	0.047 U	0.047 U	0.048 U	0.047 U	0.047 U	0.047 U
TOXAPHENE	0.097 U	0.1 U	0.094 U	0.094 U	0.097 U	0.094 U	0.094 U	0.094 U
PAHs (ug/L)								
1,4-DIOXANE	0.48 U	0.47 UJ	0.5 U	0.48 UJ	0.52 U	0.47 UJ	0.475 U	0.48 U
2-METHYLNAPHTHALENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
ACENAPHTHENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
ACENAPHTHYLENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
ANTHRACENE	0.095 UJ	0.094 UJ	0.1 U	0.095 UJ	0.1 U	0.094 UJ	0.0945 U	0.095 UJ
BAP EQUIVALENT-HALFND	0.095 U	0.094 U	0.13355	0.095 U	0.115561	0.094 U	0.0945 U	0.095 U
BAP EQUIVALENT-POS	0.095 U	0.094 U	0.023	0.095 U	0.000061	0.094 U	0.0945 U	0.095 U
BENZO(A)ANTHRACENE	0.095 UJ	0.094 UJ	0.23 J	0.095 UJ	0.1 U	0.094 UJ	0.0945 U	0.095 UJ
BENZO(A)PYRENE	0.095 UJ	0.094 U	0.1 UJ	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
BENZO(B)FLUORANTHENE	0.095 UJ	0.094 UJ	0.1 U	0.095 UJ	0.1 U	0.094 UJ	0.0945 U	0.095 UJ
BENZO(G,H,I)PERYLENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
BENZO(K)FLUORANTHENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
CHRYSENE	0.095 UJ	0.094 UJ	0.1 U	0.095 U	0.061 J	0.094 U	0.0945 U	0.095 U
DIBENZO(A,H)ANTHRACENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
FLUORANTHENE	0.095 UJ	0.094 UJ	0.1 U	0.095 UJ	0.1 UJ	0.094 UJ	0.0945 U	0.095 UJ

LOCATION	MW-QRY-01A	MW-QR'	Y-01B	MW-Q	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
FLUORENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.073 J	0.073 J
INDENO(1,2,3-CD)PYRENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
NAPHTHALENE	0.095 U	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
PHENANTHRENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
PYRENE	0.095 UJ	0.094 U	0.1 U	0.095 U	0.1 U	0.094 U	0.0945 U	0.095 U
Semivolatile Organics (ug/L)								
1,1-BIPHENYL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
1,2,4,5-TETRACHLOROBENZENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
2,2'-OXYBIS(1-CHLOROPROPANE)	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
2,3,4,6-TETRACHLOROPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
2,4,5-TRICHLOROPHENOL	18 U	18 U	19 U	18 U	19 U	18 UR	18 R	18 UR
2,4,6-TRICHLOROPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
2,4-DICHLOROPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
2,4-DIMETHYLPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
2,4-DINITROPHENOL	18 U	18 U	19 U	18 U	19 U	18 UR	18 R	18 UR
2,4-DINITROTOLUENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
2,6-DINITROTOLUENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
2-CHLORONAPHTHALENE	7.1 UJ	7.1 UJ	7.5 UJ	7.1 UJ	7.7 UJ	7.1 UJ	7.1 U	7.1 UJ
2-CHLOROPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
2-METHYLPHENOL	7.1 U	7.1 UJ	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
2-NITROANILINE	18 U	18 U	19 U	18 U	19 U	18 U	18 U	18 U
2-NITROPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
3&4-METHYLPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
3,3'-DICHLOROBENZIDINE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
3-NITROANILINE	18 U	18 U	19 U	18 U	19 U	18 U	18 U	18 U
4,6-DINITRO-2-METHYLPHENOL	18 U	18 U	19 U	18 U	19 U	18 UR	18 R	18 UR
4-BROMOPHENYL PHENYL ETHER	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
4-CHLORO-3-METHYLPHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
4-CHLOROANILINE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
4-CHLOROPHENYL PHENYL ETHER	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
4-NITROANILINE	18 UJ	18 U	19 U	18 U	19 U	18 U	18 U	18 U
4-NITROPHENOL	18 UJ	18 U	19 U	18 UJ	19 U	18 UR	18 R	18 UR
ATRAZINE	7.1 UJ	7.1 U	7.5 UJ	7.1 UJ	7.7 UJ	7.1 UJ	7.1 U	7.1 U

LOCATION	MW-QRY-01A	MW-QR	Y-01B	MW-QF	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
BENZALDEHYDE	7.1 U	7.1 UJ	7.5 UJ	7.1 U	7.7 UJ	7.1 U	7.1 U	7.1 UJ
BIS(2-CHLOROETHOXY)METHANE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
BIS(2-CHLOROETHYL)ETHER	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
BIS(2-ETHYLHEXYL)PHTHALATE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
BUTYL BENZYL PHTHALATE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
CAPROLACTAM	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
CARBAZOLE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
DIBENZOFURAN	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
DIETHYL PHTHALATE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
DIMETHYL PHTHALATE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
DI-N-BUTYL PHTHALATE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
DI-N-OCTYL PHTHALATE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
HEXACHLOROBENZENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
HEXACHLOROBUTADIENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
HEXACHLOROCYCLOPENTADIENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
HEXACHLOROETHANE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
ISOPHORONE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
NITROBENZENE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
N-NITROSO-DI-N-PROPYLAMINE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
N-NITROSODIPHENYLAMINE	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 U	7.1 U	7.1 U
PENTACHLOROPHENOL	18 U	18 U	19 U	18 U	19 UJ	18 UR	18 R	18 UR
PHENOL	7.1 U	7.1 U	7.5 U	7.1 U	7.7 U	7.1 UR	7.1 R	7.1 UR
Volatile Organics (ug/L)								
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
1,2,4-TRICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DIBROMO-3-CHLOROPROPANE	0.024 U	0.024 UJ	0.024 U	0.024 UJ	0.024 U	0.023 UJ	0.0235 U	0.024 UJ
1,2-DIBROMOETHANE	0.024 U	0.024 UJ	0.024 U	0.024 UJ	0.024 U	0.023 UJ	0.0235 U	0.024 UJ

LOCATION	MW-QRY-01A	MW-QR'	Y-01B	MW-Q	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
1,2-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
2-HEXANONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
4-METHYL-2-PENTANONE	2.5 U	2.5 U	2.5 UJ	2.5 U	2.5 UJ	2.5 U	2.5 U	2.5 U
ACETONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.75 U	3 U
BENZENE	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.68 J	0.685	0.69 J
BROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U	1.9	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.5 U	0.5 U
CHLOROETHANE	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	0.5 U	3.6	0.5 U	19	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1.3 J	1.35	1.4 J
METHYL ACETATE	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
METHYL CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
O-XYLENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

LOCATION	MW-QRY-01A	MW-QR'	Y-01B	MW-QI	RY-02		MW-QRY-03	
SAMPLE ID	QRYD9GW01A-1213	QRYD9GW001B-0812	QRYD9GW01B-	QRYD9GW002-0812	QRYD9GW02-1213	QRYD9GW003-0812	QRYD9GW003-0812-AVG	QRYD9GW003-0812-D
SAMPLE DATE	20131205	20120829	20131202	20120828	20131203	20120828	20120828	20120828
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	ORIG	AVG	DUP
STYRENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOTAL XYLENES	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.3 J	1.35	1.4 J
TRANS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROFLUOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VPH MADEP (ug/L)								
C5-C8 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C5-C8 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C10 AROMATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS	75 U	75 UJ	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS-UNADJ	75 U	75 UJ	75 U	75 U	75 U	75 U	75 U	75 U

LOCATION	MW-QRY-03	MW-QR'	Y-04	MW-QRY-05	MW-QRY-06	MW-QRY-07	MW-QRY-08				
SAMPLE ID	QRYD9GW03-1213	QRYD9GW004-0812	QRYD9GW04-	QRYD9GW05-1213	QRYD9GW06-1213	QRYD9GW07-1213	QRYD9GW08-1213				
SAMPLE DATE	20131202	20120829	20131204	20131204	20131203	20131204	20131204				
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL				
EPH MADEP (ug/L)											
C11-C22 AROMATICS	74 U	71 U	71 U	71 U	75 U	71 U	72 U				
C11-C22 AROMATICS-UNADJ	74 U	71 U	71 U	71 U	75 U	71 U	72 U				
C19-C36 ALIPHATICS	74 U	71 U	71 U	71 U	75 U	71 U	72 U				
C9-C18 ALIPHATICS	74 U	71 U	71 U	71 U	75 U	71 U	72 U				
Explosives (ug/L)	Explosives (ug/L)										
1,3,5-TRINITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
1,3-DINITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
2,4,6-TRINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
2,4-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
2-AMINO-4,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
2-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
3,5-DINITROANILINE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
3-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
4-AMINO-2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
4-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
HMX	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
NITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
NITROGLYCERIN	2 U	2 UJ	2 U	2 U	2 U	2 U	2 U				
PETN	2 U	2 U	2 U	2 U	2 U	2 U	2 U				
RDX	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
TETRYL	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U				
Inorganics (ug/L)	-	•		•	•		•				
ALUMINUM	53.3 U	98.9 J	82.2 J	41.3 U	40 U	739	1740				
ANTIMONY	0.5 U	0.59 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U				
ARSENIC	4 U	4 U	4 U	4 U	4 U	6.7	2.3 J				
BARIUM	23.8	225	80.4	189	57.2	29.6	82.4				
BERYLLIUM	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.36 J				
CADMIUM	0.2 U	0.09 J	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U				
CALCIUM	23000	47200	19600	81400	9730	31200	3310				
CHROMIUM	4 U	4 U	4 U	4 U	4 U	4 U	4 U				
COBALT	12	1	0.88 J	12.2	0.11 J	0.17 J	10.7				

	YD9GW08-1213 20131204 NORMAL 15.6 54.2 J 0.66 U 1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U 4 U
SAMPLE CODE NORMAL NORMAL NORMAL NORMAL NORMAL NORMAL NORMAL	NORMAL 15.6 54.2 J 0.66 U 1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
COPPER	15.6 54.2 J 0.66 U 1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
IRON	54.2 J 0.66 U 1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
LEAD	0.66 U 1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
MAGNESIUM 5700 6040 2240 8280 1820 5820 MANGANESE 1300 454 333 3070 11.9 164 MERCURY 0.1 UJ NICKEL 5.6 4.4 2.4 U 24 1.2 U 1.2 U POTASSIUM 3180 10600 4610 16400 3230 3900 SELENIUM 3 U 4 U 4 U <td>1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U</td>	1330 270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
MANGANESE 1300 454 333 3070 11.9 164 MERCURY 0.1 UJ 0.2320 3900 3900 3230 3900 3900 3230 3900 3900 3230 3900 3900 3230 3900 320 300 3U 3U <td< td=""><td>270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U</td></td<>	270 0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
MERCURY 0.1 UJ 0.1 U	0.1 UJ 19.1 1580 3 U 0.4 U 3120 0.4 U
NICKEL 5.6 4.4 2.4 U 24 1.2 U 1.2 U 1.2 U POTASSIUM 3180 10600 4610 16400 3230 3900 SELENIUM 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3	19.1 1580 3 U 0.4 U 3120 0.4 U
POTASSIUM 3180 10600 4610 16400 3230 3900 SELENIUM 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3	1580 3 U 0.4 U 3120 0.4 U
SELENIUM 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3 U 3 U 5 U	3 U 0.4 U 3120 0.4 U
SILVER 0.4 U 0.4 U 0.1 J 0.4 U 0.4 U 0.1 J SODIUM 4360 11200 3320 7790 4080 5360 THALLIUM 0.4 U 0.1 U 0.1 U 0.1 U 0.2 J 0.1 U 0.0 U 0.1 U 0.0 U </td <td>0.4 U 3120 0.4 U</td>	0.4 U 3120 0.4 U
SODIUM	3120 0.4 U
THALLIUM O.4 U O.1 U O.2 J O.1 U O.1 U O.2 J O.1 U O.4 U	0.4 U
VANADIUM A U O.94 J A U A U A U A U A U A U A U A	
ZINC 8 U 7.5 J 19.1 8 U 8 U 8 U Misc. Parameters (ug/L) PERCHLORATE 0.1 U 0.04 U 0.1 U 0.1 U 0.2 J 0.1 U PCBS (ug/L) AROCLOR-1016 0.047 U 0.047 UJ 0.048 UJ 0.048 UJ 0.049 U 0.048 UJ AROCLOR-1221 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	4 U
Misc. Parameters (ug/L) PERCHLORATE 0.1 U 0.04 U 0.1 U 0.1 U 0.2 J 0.1 U PCBS (ug/L) AROCLOR-1016 0.047 U 0.047 UJ 0.048 UJ 0.048 UJ 0.049 U 0.048 UJ AROCLOR-1221 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	
PERCHLORATE 0.1 U 0.04 U 0.1 U 0.1 U 0.2 J 0.1 U PCBS (ug/L) AROCLOR-1016 0.047 U 0.047 UJ 0.048 UJ 0.048 UJ 0.049 U 0.049 U 0.048 UJ AROCLOR-1221 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.049 U 0.048 U AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	31.6
PCBS (ug/L) AROCLOR-1016 0.047 U 0.047 UJ 0.048 UJ 0.048 UJ 0.049 U 0.048 UJ AROCLOR-1221 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	
AROCLOR-1016 0.047 U 0.047 UJ 0.048 UJ 0.048 UJ 0.049 U 0.048 UJ AROCLOR-1221 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	0.1 U
AROCLOR-1221 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.049 U 0.048 U	
AROCLOR-1232 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	0.048 U
AROCLOR-1242 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	0.048 U
AROCLOR-1248 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	0.048 U
	0.048 U
AROCI OR-1254 0.047 0.047 0.048	0.048 U
0.047 0 0.047 0 0.040 0 0.047 0 0.047 0 0.046 0	0.048 U
AROCLOR-1260 0.047 U 0.047 UJ 0.048 UJ 0.048 UJ 0.049 U 0.048 UJ	0.048 U
AROCLOR-1262 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	0.048 U
AROCLOR-1268 0.047 U 0.047 UJ 0.048 U 0.048 U 0.049 U 0.048 U	0.048 U
TOTAL AROCLOR NA 0 U NA NA NA NA	NA
TOTAL AROCLOR HALFND NA 0.2115 NA NA NA NA NA	NA
Pesticides (ug/L)	
4,4'-DDD 0.0096 U 0.0094 U 0.0096 U 0.0096 U 0.0098 U 0.0096 U	0.0095 U
4,4'-DDE 0.0096 U 0.0094 UJ 0.0096 UJ 0.0096 UJ 0.0098 U 0.0096 UJ	0.0095 UJ
4,4'-DDT 0.0096 U 0.0094 U 0.0096 U 0.0096 U 0.0098 U 0.0096 U	
ALDRIN 0.0048 U 0.0047 UJ 0.0048 UJ 0.0048 UJ 0.0049 U 0.0048 UJ	0.0095 U

LOCATION	MW-QRY-03	MW-QR	Y-04	MW-QRY-05	MW-QRY-06	MW-QRY-07	MW-QRY-08
SAMPLE ID	QRYD9GW03-1213	QRYD9GW004-0812	QRYD9GW04-	QRYD9GW05-1213	QRYD9GW06-1213	QRYD9GW07-1213	QRYD9GW08-1213
SAMPLE DATE	20131202	20120829	20131204	20131204	20131203	20131204	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
ALPHA-BHC	0.0048 U	0.0047 UJ	0.0048 UJ	0.0048 UJ	0.0049 U	0.0048 UJ	0.0048 UJ
ALPHA-CHLORDANE	0.0048 U	0.0047 U	0.0048 UJ	0.0048 UJ	0.0049 U	0.0048 UJ	0.0048 UJ
BETA-BHC	0.0048 U	0.0047 UJ	0.0048 U	0.0048 UJ	0.0049 U	0.0048 U	0.0048 U
DELTA-BHC	0.0048 U	0.0047 U	0.0048 U	0.0048 U	0.0049 U	0.0048 U	0.0048 U
DIELDRIN	0.0096 U	0.0094 UJ	0.0096 UJ	0.0096 UJ	0.0098 U	0.0096 UJ	0.0095 UJ
ENDOSULFAN I	0.0048 U	0.0047 U	0.0048 UJ	0.0048 UJ	0.0049 U	0.0048 UJ	0.0048 UJ
ENDOSULFAN II	0.0096 U	0.0094 UJ	0.0096 U	0.0096 U	0.0098 U	0.0096 U	0.0095 U
ENDOSULFAN SULFATE	0.0096 U	0.0094 U	0.0096 U	0.0096 U	0.0098 UJ	0.0096 U	0.0095 U
ENDRIN	0.0096 U	0.0094 UJ	0.0096 UJ	0.0096 UJ	0.0098 U	0.0096 UJ	0.0095 UJ
ENDRIN ALDEHYDE	0.0096 U	0.0094 U	0.0096 U	0.0096 U	0.0098 U	0.0096 U	0.0095 U
ENDRIN KETONE	0.0096 UJ	0.0094 UJ	0.0096 UJ	0.0096 UJ	0.0098 UJ	0.0096 UJ	0.0095 UJ
GAMMA-BHC (LINDANE)	0.0048 U	0.0047 UJ	0.0048 U	0.0048 U	0.0049 U	0.0048 U	0.0048 U
GAMMA-CHLORDANE	0.0048 U	0.0047 UJ	0.0048 UJ	0.0048 UJ	0.0049 U	0.0048 UJ	0.0048 UJ
HEPTACHLOR	0.0048 U	0.0047 U	0.0048 U	0.0048 U	0.0049 U	0.0048 U	0.0048 U
HEPTACHLOR EPOXIDE	0.0048 U	0.0047 U	0.0048 UJ	0.0048 UJ	0.0049 U	0.0048 UJ	0.0048 UJ
METHOXYCHLOR	0.048 U	0.047 U	0.048 U	0.048 U	0.049 U	0.048 U	0.048 U
TOXAPHENE	0.096 U	0.094 U	0.096 U	0.096 U	0.098 U	0.096 U	0.095 U
PAHs (ug/L)							
1,4-DIOXANE	0.47 U	0.48 U	0.48 U	0.47 U	0.51 U	0.48 U	0.48 U
2-METHYLNAPHTHALENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
ACENAPHTHENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
ACENAPHTHYLENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
ANTHRACENE	0.094 U	0.095 UJ	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
BAP EQUIVALENT-HALFND	0.125917	0.095 U	0.097 U	0.126917	0.1 U	0.096 U	0.097 U
BAP EQUIVALENT-POS	0.022	0.095 U	0.097 U	0.023	0.1 U	0.096 U	0.097 U
BENZO(A)ANTHRACENE	0.22 J	0.095 UJ	0.097 UJ	0.23 J	0.1 UJ	0.096 UJ	0.097 UJ
BENZO(A)PYRENE	0.094 UJ	0.095 U	0.097 UJ	0.094 UJ	0.1 UJ	0.096 UJ	0.097 UJ
BENZO(B)FLUORANTHENE	0.094 U	0.095 UJ	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
BENZO(G,H,I)PERYLENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
BENZO(K)FLUORANTHENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
CHRYSENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
DIBENZO(A,H)ANTHRACENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
FLUORANTHENE	0.094 U	0.095 UJ	0.097 UJ	0.13 U	0.1 U	0.096 UJ	0.097 UJ

LOCATION	MW-QRY-03	MW-QR'	Y-04	MW-QRY-05	MW-QRY-06	MW-QRY-07	MW-QRY-08
SAMPLE ID	QRYD9GW03-1213	QRYD9GW004-0812	QRYD9GW04-	QRYD9GW05-1213	QRYD9GW06-1213	QRYD9GW07-1213	QRYD9GW08-1213
SAMPLE DATE	20131202	20120829	20131204	20131204	20131203	20131204	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
FLUORENE	0.094 U	0.095 U	0.097 UJ	0.062 J	0.1 U	0.096 UJ	0.097 UJ
INDENO(1,2,3-CD)PYRENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
NAPHTHALENE	0.094 U	0.095 U	0.097 U	0.094 U	0.1 U	0.096 U	0.097 U
PHENANTHRENE	0.094 U	0.095 U	0.097 UJ	0.19 J	0.1 U	0.096 UJ	0.097 UJ
PYRENE	0.094 U	0.095 U	0.097 UJ	0.094 UJ	0.1 U	0.096 UJ	0.097 UJ
Semivolatile Organics (ug/L)							
1,1-BIPHENYL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
1,2,4,5-TETRACHLOROBENZENE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2,2'-OXYBIS(1-CHLOROPROPANE)	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2,3,4,6-TETRACHLOROPHENOL	7.1 UJ	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2,4,5-TRICHLOROPHENOL	18 U	18 U	18 U	18 U	19 U	18 U	18 U
2,4,6-TRICHLOROPHENOL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2,4-DICHLOROPHENOL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2,4-DIMETHYLPHENOL	7.1 U	7.1 U	7.3 U	7.1 UJ	7.6 U	7.2 U	7.3 U
2,4-DINITROPHENOL	18 UJ	18 U	18 U	18 U	19 U	18 U	18 U
2,4-DINITROTOLUENE	7.1 UJ	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2,6-DINITROTOLUENE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2-CHLORONAPHTHALENE	7.1 U	7.1 UJ	7.3 UJ	7.1 UJ	7.6 UJ	7.2 UJ	7.3 UJ
2-CHLOROPHENOL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
2-METHYLPHENOL	7.1 U	7.1 U	7.3 U	7.1 UJ	7.6 U	7.2 U	7.3 U
2-NITROANILINE	18 U	18 U	18 U	18 U	19 U	18 U	18 U
2-NITROPHENOL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
3&4-METHYLPHENOL	7.1 U	7.1 U	12	7.1 UJ	7.6 U	7.2 U	7.3 U
3,3'-DICHLOROBENZIDINE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
3-NITROANILINE	18 UJ	18 U	18 U	18 U	19 U	18 U	18 U
4,6-DINITRO-2-METHYLPHENOL	18 UJ	18 U	18 U	18 U	19 U	18 U	18 U
4-BROMOPHENYL PHENYL ETHER	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
4-CHLORO-3-METHYLPHENOL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
4-CHLOROANILINE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
4-CHLOROPHENYL PHENYL ETHER	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
4-NITROANILINE	18 UJ	18 U	18 U	18 U	19 U	18 UJ	18 UJ
4-NITROPHENOL	18 UJ	18 U	18 U	18 U	19 U	18 UJ	18 UJ
ATRAZINE	7.1 UJ	7.1 U	7.3 UJ	7.1 UJ	7.6 UJ	7.2 UJ	7.3 UJ

LOCATION	MW-QRY-03	MW-QR'	Y-04	MW-QRY-05	MW-QRY-06	MW-QRY-07	MW-QRY-08
SAMPLE ID	QRYD9GW03-1213	QRYD9GW004-0812	QRYD9GW04-	QRYD9GW05-1213	QRYD9GW06-1213	QRYD9GW07-1213	QRYD9GW08-1213
SAMPLE DATE	20131202	20120829	20131204	20131204	20131203	20131204	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
BENZALDEHYDE	7.1 UJ	7.1 UJ	7.3 UJ	7.1 UJ	7.6 UJ	7.2 U	7.3 U
BIS(2-CHLOROETHOXY)METHANE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
BIS(2-CHLOROETHYL)ETHER	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
BIS(2-ETHYLHEXYL)PHTHALATE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
BUTYL BENZYL PHTHALATE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
CAPROLACTAM	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
CARBAZOLE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
DIBENZOFURAN	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
DIETHYL PHTHALATE	7.1 UJ	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
DIMETHYL PHTHALATE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
DI-N-BUTYL PHTHALATE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
DI-N-OCTYL PHTHALATE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
HEXACHLOROBENZENE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
HEXACHLOROBUTADIENE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
HEXACHLOROCYCLOPENTADIENE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
HEXACHLOROETHANE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
ISOPHORONE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
NITROBENZENE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
N-NITROSO-DI-N-PROPYLAMINE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
N-NITROSODIPHENYLAMINE	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
PENTACHLOROPHENOL	18 UJ	18 U	18 U	18 UJ	19 UJ	18 U	18 U
PHENOL	7.1 U	7.1 U	7.3 U	7.1 U	7.6 U	7.2 U	7.3 U
Volatile Organics (ug/L)							
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
1,2,4-TRICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DIBROMO-3-CHLOROPROPANE	0.024 U	0.024 UJ	0.024 U	0.024 U	0.024 U	0.024 U	0.024 U
1,2-DIBROMOETHANE	0.024 U	0.024 UJ	0.024 U	0.024 U	0.024 U	0.024 U	0.024 U

LOCATION	MW-QRY-03	MW-QR	Y-04	MW-QRY-05	MW-QRY-06	MW-QRY-07	MW-QRY-08
SAMPLE ID	QRYD9GW03-1213	QRYD9GW004-0812	QRYD9GW04-	QRYD9GW05-1213	QRYD9GW06-1213	QRYD9GW07-1213	QRYD9GW08-1213
SAMPLE DATE	20131202	20120829	20131204	20131204	20131203	20131204	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
1,2-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
2-HEXANONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
4-METHYL-2-PENTANONE	2.5 UJ	2.5 U	2.5 U	2.5 U	2.5 UJ	2.5 U	2.5 U
ACETONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
BENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
BROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U	0.5 U
CHLOROETHANE	1 U	1 U	1 UJ	1 U	1 U	1 U	1 U
CHLOROFORM	0.5 U	5.2	0.5 U	1.3 J	0.5 U	0.5 U	0.5 U
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U	1 U
METHYL ACETATE	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
METHYL CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
O-XYLENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

LOCATION	MW-QRY-03	MW-QR	Y-04	MW-QRY-05	MW-QRY-06	MW-QRY-07	MW-QRY-08
SAMPLE ID	QRYD9GW03-1213	QRYD9GW004-0812	QRYD9GW04-	QRYD9GW05-1213	QRYD9GW06-1213	QRYD9GW07-1213	QRYD9GW08-1213
SAMPLE DATE	20131202	20120829	20131204	20131204	20131203	20131204	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
STYRENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	33	0.5 U	0.5 U	0.5 U	0.5 U
TOTAL XYLENES	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
TRANS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROFLUOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U	1 U
VPH MADEP (ug/L)							
C5-C8 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C5-C8 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C10 AROMATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U	75 U

LOCATION	MW-QRY-09			MW-QRY-10	MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
EPH MADEP (ug/L)						
C11-C22 AROMATICS	71 U	71 U	71 U	75 U	71 U	71 U
C11-C22 AROMATICS-UNADJ	71 U	71 U	71 U	75 U	71 U	71 U
C19-C36 ALIPHATICS	71 U	71 U	71 U	75 U	71 U	71 U
C9-C18 ALIPHATICS	71 U	71 U	71 U	75 U	71 UJ	71 U
Explosives (ug/L)						
1,3,5-TRINITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
1,3-DINITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2,4,6-TRINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2,4-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2-AMINO-4,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
2-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
3,5-DINITROANILINE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
3-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
4-AMINO-2,6-DINITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
4-NITROTOLUENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
HMX	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.61
NITROBENZENE	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
NITROGLYCERIN	2 U	2 U	2 U	2 U	2 U	2 U
PETN	2 U	2 U	2 U	2 U	2 U	2 U
RDX	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	3.8
TETRYL	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
Inorganics (ug/L)						
ALUMINUM	266 J	295	324	73.2 J	40 U	70.2 J
ANTIMONY	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ARSENIC	4 U	4 U	4 U	4 U	4 U	4 U
BARIUM	37.8	38.65	39.5	19	27.9	89.4
BERYLLIUM	0.24 J	0.235	0.23 J	0.2 U	0.2 U	0.2 U
CADMIUM	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
CALCIUM	2010	2060	2110	12000	8080	78800
CHROMIUM	4 U	4 U	4 U	4 U	4 U	4 U
COBALT	2.6	2.7	2.8	0.94 J	0.12 J	0.27 J

LOCATION		MW-QRY-09			MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
COPPER	2.5 U	2.25 U	2 U	2 U	2.4 U	18.5
IRON	58.2 J	50.9	43.6 J	77.8 J	17.7 J	249
LEAD	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
MAGNESIUM	830	835.5	841	2600	1390	6460
MANGANESE	637	637.5	638	216	10.9	1670
MERCURY	0.1 UJ	0.1 U	0.1 UJ	0.1 UJ	0.1 UJ	0.1 U
NICKEL	1.8 U	1.95 U	2.1 U	2.5 U	1.2 U	1.8 U
POTASSIUM	1120	1125	1130	2100	1570	9160
SELENIUM	3 U	3 U	3 U	3 U	3 U	3 U
SILVER	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
SODIUM	6600	6665	6730	4980	3400	5760
THALLIUM	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
VANADIUM	4 U	4 U	4 U	4 U	4 U	4 U
ZINC	11.6	9.95	8.3 J	8 U	8 U	8 U
Misc. Parameters (ug/L)						
PERCHLORATE	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
PCBS (ug/L)						
AROCLOR-1016	0.048 UJ	0.048 U	0.048 UJ	0.05 U	0.048 U	0.048 UJ
AROCLOR-1221	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
AROCLOR-1232	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
AROCLOR-1242	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
AROCLOR-1248	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
AROCLOR-1254	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
AROCLOR-1260	0.048 UJ	0.048 U	0.048 UJ	0.05 U	0.048 U	0.048 U
AROCLOR-1262	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
AROCLOR-1268	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
TOTAL AROCLOR	NA	NA	NA	NA	NA	NA
TOTAL AROCLOR HALFND	NA	NA	NA	NA	NA	NA
Pesticides (ug/L)						
4,4'-DDD	0.0096 U	0.00955 U	0.0095 U	0.01 U	0.0097 U	0.0095 UJ
4,4'-DDE	0.0096 UJ	0.00955 U	0.0095 UJ	0.01 U	0.0097 U	0.0095 UJ
4,4'-DDT	0.0096 U	0.00955 U	0.0095 U	0.01 U	0.0097 U	0.0095 U
ALDRIN	0.0048 UJ	0.0048 U	0.0048 UJ	0.005 U	0.0048 U	0.0048 UJ

LOCATION		MW-QRY-09		MW-QRY-10	MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
ALPHA-BHC	0.0048 UJ	0.0048 U	0.0048 UJ	0.005 U	0.0048 U	0.0048 UJ
ALPHA-CHLORDANE	0.0048 UJ	0.0048 U	0.0048 UJ	0.005 U	0.0048 U	0.0048 UJ
BETA-BHC	0.0048 U	0.0048 U	0.0048 U	0.005 U	0.0048 U	0.0048 UJ
DELTA-BHC	0.0048 U	0.0048 U	0.0048 U	0.005 U	0.0048 U	0.0048 U
DIELDRIN	0.0096 UJ	0.00955 U	0.0095 UJ	0.01 U	0.0097 U	0.0095 UJ
ENDOSULFAN I	0.0048 UJ	0.0048 U	0.0048 UJ	0.005 U	0.0048 U	0.0048 UJ
ENDOSULFAN II	0.0096 U	0.00955 U	0.0095 U	0.01 U	0.0097 U	0.0095 U
ENDOSULFAN SULFATE	0.0096 U	0.00955 U	0.0095 U	0.01 U	0.0097 UJ	0.0095 U
ENDRIN	0.0096 UJ	0.00955 U	0.0095 UJ	0.01 U	0.0097 U	0.0095 UJ
ENDRIN ALDEHYDE	0.0096 U	0.00955 U	0.0095 U	0.01 U	0.0097 U	0.0095 U
ENDRIN KETONE	0.0096 UJ	0.00955 U	0.0095 UJ	0.01 UJ	0.0097 UJ	0.0095 UJ
GAMMA-BHC (LINDANE)	0.0048 U	0.0048 U	0.0048 U	0.005 U	0.0048 U	0.0048 UJ
GAMMA-CHLORDANE	0.0048 UJ	0.0048 U	0.0048 UJ	0.005 U	0.0048 U	0.0048 UJ
HEPTACHLOR	0.0048 U	0.0048 U	0.0048 U	0.005 U	0.0048 U	0.0048 U
HEPTACHLOR EPOXIDE	0.0048 UJ	0.0048 U	0.0048 UJ	0.005 U	0.0048 U	0.0048 UJ
METHOXYCHLOR	0.048 U	0.048 U	0.048 U	0.05 U	0.048 U	0.048 U
TOXAPHENE	0.096 U	0.0955 U	0.095 U	0.1 U	0.097 U	0.095 U
PAHs (ug/L)						
1,4-DIOXANE	0.47 U	0.475 U	0.48 U	0.5 U	0.48 U	0.48 U
2-METHYLNAPHTHALENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
ACENAPHTHENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
ACENAPHTHYLENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
ANTHRACENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
BAP EQUIVALENT-HALFND	0.094 U	0.095 U	0.096 U	0.115561	0.128128	0.096 U
BAP EQUIVALENT-POS	0.094 U	0.095 U	0.096 U	0.000061	0.022	0.096 U
BENZO(A)ANTHRACENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.22 J	0.096 UJ
BENZO(A)PYRENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 UJ	0.096 UJ
BENZO(B)FLUORANTHENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
BENZO(G,H,I)PERYLENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
BENZO(K)FLUORANTHENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
CHRYSENE	0.094 UJ	0.095 U	0.096 UJ	0.061 J	0.096 U	0.096 UJ
DIBENZO(A,H)ANTHRACENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
FLUORANTHENE	0.094 UJ	0.095 U	0.096 UJ	0.1 UJ	0.096 U	0.096 UJ

LOCATION		MW-QRY-09		MW-QRY-10	MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
FLUORENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
INDENO(1,2,3-CD)PYRENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
NAPHTHALENE	0.094 U	0.095 U	0.096 U	0.1 U	0.096 U	0.096 U
PHENANTHRENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
PYRENE	0.094 UJ	0.095 U	0.096 UJ	0.1 U	0.096 U	0.096 UJ
Semivolatile Organics (ug/L)						
1,1-BIPHENYL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
1,2,4,5-TETRACHLOROBENZENE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2,2'-OXYBIS(1-CHLOROPROPANE)	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2,3,4,6-TETRACHLOROPHENOL	7.1 U	7.15 U	7.2 U	7.6 UJ	7.2 U	7.2 U
2,4,5-TRICHLOROPHENOL	18 U	18 U	18 U	19 U	18 U	18 U
2,4,6-TRICHLOROPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2,4-DICHLOROPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2,4-DIMETHYLPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2,4-DINITROPHENOL	18 U	18 U	18 U	19 UJ	18 U	18 U
2,4-DINITROTOLUENE	7.1 U	7.15 U	7.2 U	7.6 UJ	7.2 U	7.2 U
2,6-DINITROTOLUENE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2-CHLORONAPHTHALENE	7.1 UJ	7.15 U	7.2 UJ	7.6 U	7.2 UJ	7.2 UJ
2-CHLOROPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2-METHYLPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
2-NITROANILINE	18 U	18 U	18 U	19 U	18 U	18 U
2-NITROPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
3&4-METHYLPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
3,3'-DICHLOROBENZIDINE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
3-NITROANILINE	18 U	18 U	18 U	19 UJ	18 U	18 U
4,6-DINITRO-2-METHYLPHENOL	18 U	18 U	18 U	19 UJ	18 U	18 U
4-BROMOPHENYL PHENYL ETHER	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
4-CHLORO-3-METHYLPHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
4-CHLOROANILINE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
4-CHLOROPHENYL PHENYL ETHER	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
4-NITROANILINE	18 UJ	18 U	18 UJ	19 UJ	18 U	18 UJ
4-NITROPHENOL	18 UJ	18 U	18 UJ	19 UJ	18 U	18 UJ
ATRAZINE	7.1 UJ	7.15 U	7.2 UJ	7.6 UJ	7.2 UJ	7.2 UJ

LOCATION		MW-QRY-09		MW-QRY-10	MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
BENZALDEHYDE	7.1 U	7.15 U	7.2 U	7.6 UJ	7.2 UJ	7.2 U
BIS(2-CHLOROETHOXY)METHANE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
BIS(2-CHLOROETHYL)ETHER	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
BIS(2-ETHYLHEXYL)PHTHALATE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
BUTYL BENZYL PHTHALATE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
CAPROLACTAM	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
CARBAZOLE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
DIBENZOFURAN	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
DIETHYL PHTHALATE	7.1 U	7.15 U	7.2 U	7.6 UJ	7.2 U	7.2 U
DIMETHYL PHTHALATE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
DI-N-BUTYL PHTHALATE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
DI-N-OCTYL PHTHALATE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
HEXACHLOROBENZENE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
HEXACHLOROBUTADIENE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
HEXACHLOROCYCLOPENTADIENE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
HEXACHLOROETHANE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
ISOPHORONE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
NITROBENZENE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
N-NITROSO-DI-N-PROPYLAMINE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
N-NITROSODIPHENYLAMINE	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
PENTACHLOROPHENOL	18 U	18 U	18 U	19 UJ	18 UJ	18 U
PHENOL	7.1 U	7.15 U	7.2 U	7.6 U	7.2 U	7.2 U
Volatile Organics (ug/L)						
1,1,1-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHA	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	0.5 UJ	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ	0.5 UJ
1,2,4-TRICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DIBROMO-3-CHLOROPROPANE	0.024 U	0.024 U	0.024 U	0.024 U	0.024 U	0.024 U
1,2-DIBROMOETHANE	0.024 U	0.024 U	0.024 U	0.024 U	0.024 U	0.024 U

LOCATION		MW-QRY-09		MW-QRY-10	MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
1,2-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
2-HEXANONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
4-METHYL-2-PENTANONE	2.5 U	2.5 U	2.5 U	2.5 UJ	2.5 UJ	2.5 U
ACETONE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
BENZENE	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
BROMOCHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 U
CHLOROETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CHLOROFORM	0.5 U	0.5 U	0.5 U	0.5 U	1.5	0.5 U
CHLOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
M+P-XYLENES	1 U	1 U	1 U	1 U	1 U	1 U
METHYL ACETATE	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
METHYL CYCLOHEXANE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
O-XYLENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

LOCATION		MW-QRY-09		MW-QRY-10	MW-QRY-11	MW-QRY-12
SAMPLE ID	QRYD9GW09-1213	QRYD9GW09-1213-	QRYD9GW09-1213-D	QRYD9GW10-1213	QRYD9GW11-1213	QRYD9GW12-1213
SAMPLE DATE	20131205	20131205	20131205	20131203	20131203	20131205
SAMPLE CODE	ORIG	AVG	DUP	NORMAL	NORMAL	NORMAL
STYRENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOTAL XYLENES	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
TRANS-1,2-DICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROFLUOROMETHANE	1 U	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	1 U	1 U	1 U	1 U	1 U	1 U
VPH MADEP (ug/L)						
C5-C8 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U
C5-C8 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U
C9-C10 AROMATICS	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U

SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413
SAMPLE DATE					20121205	20121202	20121204
	20120827	20120827	20120828	20120828	20131205	20131202	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	QC .	QC T: DI	QC	QC	QC	QC	QC T : St !
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank
EPH MADEP (UG/L)	T =/	T				T	
C11-C22 AROMATICS	76 U	NA	NA	71 U	72 UJ	NA	NA
C11-C22 AROMATICS-UNADJ	76 U	NA	NA	71 U	72 UJ	NA	NA
C19-C36 ALIPHATICS	76 U	NA	NA	71 U	72 UJ	NA	NA
C9-C18 ALIPHATICS	76 U	NA	NA	71 U	72 UJ	NA	NA
EXPLOSIVES (UG/L)	_						
1,3,5-TRINITROBENZENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
1,3-DINITROBENZENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
2,4,6-TRINITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
2,4-DINITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
2,6-DINITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
2-AMINO-4,6-DINITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
2-NITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
3,5-DINITROANILINE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
3-NITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
4-AMINO-2,6-DINITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
4-NITROTOLUENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
HMX	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
NITROBENZENE	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
NITROGLYCERIN	2 UJ	NA	NA	2 UJ	2 U	NA	NA
PETN	2 U	NA	NA	2 U	2 U	NA	NA
RDX	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
TETRYL	0.12 U	NA	NA	0.12 U	0.12 U	NA	NA
METALS (UG/L)	•					•	
ALUMINUM	6.9 J	NA	NA	7.7 J	16.2 J	NA	NA
ANTIMONY	0.14 J	NA	NA	0.12 J	0.5 U	NA	NA
ARSENIC	4 U	NA	NA	4 U	4 U	NA	NA
BARIUM	1 U	NA	NA	1 U	1 U	NA	NA
BERYLLIUM	0.2 U	NA	NA	0.2 U	0.2 U	NA	NA
CADMIUM	0.2 U	NA	NA	0.2 U	0.2 U	NA	NA
CALCIUM	80 U	NA	NA	80 U	38.4 J	NA	NA
CHROMIUM	0.52 J	NA	NA	0.42 J	1.4 J	NA	NA

SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413
SAMPLE DATE	20120827	20120827	20120828	20120828	20131205	20131202	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	QC	QC	QC	QC	QC	QC	QC
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank
COBALT	0.3 U	NA	NA	0.3 U	0.3 J	NA	NA
COPPER	3.1	NA	NA	0.39 J	1.4 J	NA	NA
IRON	60 U	NA	NA	60 U	60 U	NA	NA
LEAD	0.49 J	NA	NA	0.08 J	0.22 J	NA	NA
MAGNESIUM	11.2 J	NA	NA	11.3 J	9.3 J	NA	NA
MANGANESE	0.68 J	NA	NA	1.4 J	2.8	NA	NA
MERCURY	0.02 J	NA	NA	0.1 U	0.1 U	NA	NA
NICKEL	0.25 J	NA	NA	0.16 J	0.92 J	NA	NA
POTASSIUM	400 U	NA	NA	400 U	38.9 J	NA	NA
SELENIUM	0.42 J	NA	NA	0.86 J	3 U	NA	NA
SILVER	0.4 U	NA	NA	0.4 U	0.4 U	NA	NA
SODIUM	32.8 J	NA	NA	45.6 J	178 J	NA	NA
THALLIUM	0.4 U	NA	NA	0.4 U	0.4 U	NA	NA
VANADIUM	4 U	NA	NA	4 U	0.92 J	NA	NA
ZINC	8 U	NA	NA	8 U	7.9 J	NA	NA
MISCELLANEOUS PARAMETE	RS (UG/L)						
PERCHLORATE	0.04 U	NA	NA	0.04 U	0.1 U	NA	NA
PCBS (UG/L)							
AROCLOR-1016	0.048 UJ	NA	NA	0.048 UJ	0.048 UJ	NA	NA
AROCLOR-1221	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
AROCLOR-1232	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
AROCLOR-1242	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
AROCLOR-1248	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
AROCLOR-1254	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
AROCLOR-1260	0.048 UJ	NA	NA	0.048 UJ	0.048 UJ	NA	NA
AROCLOR-1262	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
AROCLOR-1268	0.048 U	NA	NA	0.048 U	0.048 U	NA	NA
TOTAL AROCLOR	0 U	NA	NA	0 U	NA	NA	NA
TOTAL AROCLOR HALFND	0.216	NA	NA	0.216	NA	NA	NA
PESTICIDES (UG/L)							
4,4'-DDD	0.0096 U	NA	NA	0.0096 U	0.0097 U	NA	NA
4,4'-DDE	0.0096 U	NA	NA	0.0096 UJ	0.0097 UJ	NA	NA

SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413
SAMPLE DATE	20120827	20120827	20120828	20120828	20131205	20131202	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	QC	QC	QC	QC	QC	QC	QC
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank
4,4'-DDT	0.0096 U	NA	NA	0.0096 U	0.0097 U	NA	NA
ALDRIN	0.0048 U	NA	NA	0.0048 UJ	0.0048 UJ	NA	NA
ALPHA-BHC	0.0048 U	NA	NA	0.0048 UJ	0.0048 UJ	NA	NA
ALPHA-CHLORDANE	0.0048 U	NA	NA	0.0048 U	0.0048 UJ	NA	NA
BETA-BHC	0.0048 U	NA	NA	0.0048 UJ	0.0048 U	NA	NA
DELTA-BHC	0.0048 U	NA	NA	0.0048 U	0.0048 U	NA	NA
DIELDRIN	0.0096 U	NA	NA	0.0096 UJ	0.0097 UJ	NA	NA
ENDOSULFAN I	0.0048 U	NA	NA	0.0048 U	0.0048 UJ	NA	NA
ENDOSULFAN II	0.0096 U	NA	NA	0.0096 UJ	0.0097 U	NA	NA
ENDOSULFAN SULFATE	0.0096 U	NA	NA	0.0096 U	0.0097 U	NA	NA
ENDRIN	0.0096 U	NA	NA	0.0096 UJ	0.0097 UJ	NA	NA
ENDRIN ALDEHYDE	0.0096 U	NA	NA	0.0096 U	0.0097 U	NA	NA
ENDRIN KETONE	0.0096 U	NA	NA	0.0096 UJ	0.0097 UJ	NA	NA
GAMMA-BHC (LINDANE)	0.0048 U	NA	NA	0.0048 UJ	0.0048 U	NA	NA
GAMMA-CHLORDANE	0.0048 U	NA	NA	0.0048 UJ	0.0048 UJ	NA	NA
HEPTACHLOR	0.0048 U	NA	NA	0.0048 U	0.0048 U	NA	NA
HEPTACHLOR EPOXIDE	0.0088 J	NA	NA	0.0048 U	0.0048 UJ	NA	NA
METHOXYCHLOR	0.0094 J	NA	NA	0.048 U	0.048 U	NA	NA
TOXAPHENE	0.096 U	NA	NA	0.096 U	0.097 U	NA	NA
POLYCYCLIC AROMATIC HYD	ROCARBONS (UG/L)						
1,4-DIOXANE	0.48 UJ	NA	NA	0.47 U	0.48 U	NA	NA
2-METHYLNAPHTHALENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA
ACENAPHTHENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA
ACENAPHTHYLENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA
ANTHRACENE	0.095 UJ	NA	NA	0.094 UJ	0.095 UJ	NA	NA
BAP EQUIVALENT-HALFND	0.095 U	NA	NA	0.094 U	NA	NA	NA
BAP EQUIVALENT-POS	0.095 U	NA	NA	0.094 U	NA	NA	NA
BENZO(A)ANTHRACENE	0.095 UJ	NA	NA	0.094 UJ	0.22 J	NA	NA
BENZO(A)PYRENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA
BENZO(B)FLUORANTHENE	0.095 UJ	NA	NA	0.094 UJ	0.095 UJ	NA	NA
BENZO(G,H,I)PERYLENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA
BENZO(K)FLUORANTHENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA

QUALITY CONTROL SAINI LE RESOLTS SONIMARY									
SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413		
SAMPLE DATE	20120827	20120827	20120828	20120828	20131205	20131202	20131204		
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL		
MATRIX	QC	QC	QC	QC	QC	QC	QC		
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank		
CHRYSENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA		
DIBENZO(A,H)ANTHRACENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA		
FLUORANTHENE	0.095 UJ	NA	NA	0.094 UJ	0.095 U	NA	NA		
FLUORENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA		
INDENO(1,2,3-CD)PYRENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA		
NAPHTHALENE	0.095 UJ	NA	NA	0.094 U	0.095 U	NA	NA		
PHENANTHRENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA		
PYRENE	0.095 UJ	NA	NA	0.094 U	0.095 UJ	NA	NA		
SEMIVOLATILES (UG/L)	•								
1,1-BIPHENYL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
1,2,4,5-TETRACHLOROBENZENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,2'-OXYBIS(1-CHLOROPROPANE)	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,3,4,6-TETRACHLOROPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,4,5-TRICHLOROPHENOL	18 U	NA	NA	18 U	18 U	NA	NA		
2,4,6-TRICHLOROPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,4-DICHLOROPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,4-DIMETHYLPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,4-DINITROPHENOL	18 U	NA	NA	18 U	18 U	NA	NA		
2,4-DINITROTOLUENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2,6-DINITROTOLUENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2-CHLORONAPHTHALENE	7.1 U	NA	NA	7.1 UJ	7.1 UJ	NA	NA		
2-CHLOROPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2-METHYLPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
2-NITROANILINE	18 U	NA	NA	18 U	18 U	NA	NA		
2-NITROPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
3&4-METHYLPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
3,3'-DICHLOROBENZIDINE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
3-NITROANILINE	18 U	NA	NA	18 U	18 U	NA	NA		
4,6-DINITRO-2-METHYLPHENOL	18 U	NA	NA	18 U	18 U	NA	NA		
4-BROMOPHENYL PHENYL ETHER	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
4-CHLORO-3-METHYLPHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		
4-CHLOROANILINE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA		

SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413
SAMPLE DATE	20120827	20120827	20120828	20120828	20131205	20131202	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	QC	QC	QC	QC	QC	QC	QC
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank
4-CHLOROPHENYL PHENYL ETHER	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
4-NITROANILINE	18 U	NA	NA	18 U	18 UJ	NA	NA
4-NITROPHENOL	18 U	NA	NA	18 U	18 UJ	NA	NA
ATRAZINE	7.1 UJ	NA	NA	7.1 U	7.1 UJ	NA	NA
BENZALDEHYDE	4.6 J	NA	NA	2.4 J	9 J	NA	NA
BIS(2-CHLOROETHOXY)METHANE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
BIS(2-CHLOROETHYL)ETHER	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
BIS(2-ETHYLHEXYL)PHTHALATE	7.1 U	NA	NA	18	7.1 U	NA	NA
BUTYL BENZYL PHTHALATE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
CAPROLACTAM	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
CARBAZOLE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
DIBENZOFURAN	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
DIETHYL PHTHALATE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
DIMETHYL PHTHALATE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
DI-N-BUTYL PHTHALATE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
DI-N-OCTYL PHTHALATE	7.1 U	NA	NA	7.1 UJ	7.1 U	NA	NA
HEXACHLOROBENZENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
HEXACHLOROBUTADIENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
HEXACHLOROCYCLOPENTADIENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
HEXACHLOROETHANE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
ISOPHORONE	7.1 UJ	NA	NA	7.1 U	7.1 U	NA	NA
NITROBENZENE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
N-NITROSO-DI-N-PROPYLAMINE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
N-NITROSODIPHENYLAMINE	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
PENTACHLOROPHENOL	18 U	NA	NA	18 U	18 U	NA	NA
PHENOL	7.1 U	NA	NA	7.1 U	7.1 U	NA	NA
VOLATILES (UG/L)							
1,1,1-TRICHLOROETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2,2-TETRACHLOROETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-TRICHLOROTRIFLUOROETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-DICHLOROETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413
SAMPLE DATE	20120827	20120827	20120828	20120828	20131205	20131202	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	QC	QC	QC	QC	QC	QC	QC
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank
1,1-DICHLOROETHENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2,3-TRICHLOROBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 UJ	0.5 UJ
1,2,4-TRICHLOROBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DIBROMO-3-CHLOROPROPANE	0.025 UJ	0.025 UJ	0.023 UJ	0.024 UJ	0.024 U	0.024 U	0.024 U
1,2-DIBROMOETHANE	0.025 UJ	0.025 UJ	0.023 UJ	0.024 UJ	0.024 U	0.024 U	0.024 U
1,2-DICHLOROBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-DICHLOROPROPANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,3-DICHLOROBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,4-DICHLOROBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-BUTANONE	10 J	2.5 U	2.5 U	4.7 J	2.5 J	2.5 U	2.5 U
2-HEXANONE	2.5 UJ	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
4-METHYL-2-PENTANONE	2.5 UJ	2.5 U	2.5 U	2.5 U	2.5 U	2.5 UJ	2.5 U
ACETONE	20 J	2.5 U	2.5 U	11	5.7	2.5 U	2.5 U
BENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
BROMOCHLOROMETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMODICHLOROMETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOFORM	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
BROMOMETHANE	1 UJ	1 UJ	1 U	1 U	1 U	1 U	1 U
CARBON DISULFIDE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CARBON TETRACHLORIDE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLORODIBROMOMETHANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 UJ	0.5 U
CHLOROETHANE	1 UJ	1 UJ	1 U	1 U	1 UJ	1 U	1 U
CHLOROFORM	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CHLOROMETHANE	1 UJ	1 U	1 U	1.4 J	1 U	1 U	1 U
CIS-1,2-DICHLOROETHENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CIS-1,3-DICHLOROPROPENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CYCLOHEXANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
DICHLORODIFLUOROMETHANE	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U
ETHYLBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
ISOPROPYLBENZENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

SAMPLE ID	QRY/12GWFB01-082712	QRY/12GWTB01-082712	QRY/12GWTB02-082812	QRYD9GWRB01-082812	QRYD9-GWRB01-120513	QRYD9-TB120213	QRYD9-TB120413
SAMPLE DATE	20120827	20120827	20120828	20120828	20131205	20131202	20131204
SAMPLE CODE	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX	QC	QC	QC	QC	QC	QC	QC
SAMPLE TYPE	Field Blank	Trip Blank	Trip Blank	Rinsate Blank	Rinsate Blank	Trip Blank	Trip Blank
M+P-XYLENES	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U
METHYL ACETATE	0.75 UJ	0.75 UJ	0.75 U	0.61 J	0.75 U	0.75 U	0.75 U
METHYL CYCLOHEXANE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYL TERT-BUTYL ETHER	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
METHYLENE CHLORIDE	2.5 UJ	2.5 U	2.5 U	2.5 U	2.5 U	1.5 J	3.3 J
O-XYLENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
STYRENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TETRACHLOROETHENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOLUENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TOTAL XYLENES	1.5 UJ	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U	1.5 U
TRANS-1,2-DICHLOROETHENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRANS-1,3-DICHLOROPROPENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROETHENE	0.5 UJ	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
TRICHLOROFLUOROMETHANE	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U
VINYL CHLORIDE	1 UJ	1 U	1 U	1 U	1 U	1 U	1 U
VPH MADEP (UG/L)							
C5-C8 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C5-C8 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C10 AROMATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS	75 U	75 U	75 U	75 U	75 U	75 U	75 U
C9-C12 ALIPHATICS-UNADJ	75 U	75 U	75 U	75 U	75 U	75 U	75 U

B-3 SURVEY DATA

Sheet1

NAD83 MAINE STATE PLANE WEST (US SURVEY FEET)

NOTE: ALL NEGATIVE VALUES ARE INVALID--- NOTE: ALL NEGATIVE VALUES ARE INVALID--- NOTE: ALL NEGATIVE VALI

Doint Number	Al-al-1 co		NGVD Factor=	0.65		
Point Number	Northing (Y)	Easting (X)	Elevation (Z)NAVD88	Elevation Z NGVD29	Descri tion	
5440	378154.153	3017120.378	84.055	84.70	SPK	N. H.
5441	378258.263	3017496.195	86.492	87.14	SPK	
5445	383033.916	3010476.994	95.807	96.46	SPK	
5446	383183.943	3010187.431	92.739	93.39	SPK	
15600	383207.75	3010192.33	91.96	92.61	SPKIG	
15601	382976.92	3010450.45	95.53	96.18	SPKIG	
15602	382895.01	3010432.89	120.81	121.45	SPKIG	
15610	383185.40	3010138.96	92.81	93.46	MW-QRY-03 G	
15611	383185.58	3010138.9	95.41	96.06	MW-QRY-03 C	
15612	383185.55	3010138.79	95.31	95.96	MW-QRY-03 P	
15613	383145.52	3009969.54	88.29	88.94	SG-QRY-02 3.0	
15614	382943.46	3010221.28	102.82	103.47	MW-QRY-02 G	
15615	382943.40	3010221.11	105.78	106.43	MW-QRY-02 C	
15616	382943.47	3010220.93	105.68	106.33	MW-QRY-02 P	
15617	382985.51	3010421.59	94.40	95.05	MW-QRY-04 G	
15618	382985.92	3010421.60	97.35	98.00	MW-QRY-04 C	
15619	382985.81	3010421.68	97.25	97.90	MW-QRY-04 P	
15620	382954.58	3010469.25	90.96	91.61	SG-QRY-01 3.0	
15621	382768.68	3010512.70	110.50	111.15	MW-QRY-01A G	
15622	382768.62	3010512.79	113.15	113.80	MW-QRY-01A C	
15623	382768.93	3010512.86	113.07	113.72	MW-QRY-01A P	
15624	382767.04	3010506.44	110.37	111.01	MW-QRY-018 G	
15625	382766.86	3010506.10	113.17	113.82	MW-QRY-018 C	
15626	382767.16	3010506.32	113.03	113.68	MW-QRY-018 P	
15627	383033.92	3010476.99	95.81	96.46	SPKIG GPS	
15628	383183.96	3010187.39	92.69	93.34	SPKIG GPS	
15700	378258.26	3017496.20	86.49	87.14	SPKIG	
15701	378154.15	3017120.38	84.06	84.71	SPKIG	
15710	378225.33	3017605.72	77.99	78.64	SG-12-01 3.0	
15711	378401.49	3017524.82	79.22	79.87	MW-12-03 G	
15712	378401.22	3017524.42	82.05	82.70	MW-12-03 G MW-12-03 C	
15713	378401.68	3017524.59	82.00	82.65	MW-12-03 C MW-12-03 P	

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15714	378227.96	3017325.21	77.93	78.58	MW-12-02 G
15715	378228.20	3017325.04	80.58	81.23	MW-12-02 C
15716	378228.49	3017325.21	80.51	81.16	MW-12-02 P
15717	378355.99	3017222.82	74.94	75.59	MW-12-01 G
15718	378356.35	3017222.82	77.70	78.35	MW-12-01 C
15719	378356.30	3017223.06	77.60	78.25	MW-12-01 P

Sheet1

NAD83 MAINE STATE PLANE WEST (METERS)
UES ARE INVALID ---NOTE: ALL NEGATIVE VALUES ARE INVALID --- NOTE: ALL NEGATIVE VALUES ARE INVALID ---

			NGVD Factor=	0.20	
Point Number	Northing (Y)	Easting (X)	Elevation (Z)NAVD88	Elevation (Z) NGVD29	Description
5440	115261.62	919620.13	25.62	25.82	SPK
5441	115293.35	919734.68	26.36	26.56	SPK
5445	116748.97	917595.22	29.20	29.40	SPK
5446	116794.70	917506.96	28.27	28.47	SPK
15600	116801.96	917508.46	28.03	28.23	SPKIG
15601	116731.60	917587.13	29.12	29.32	SPKIG
15602	116706.63	917581.78	36.82	37.02	SPKIG
15610	116795.14	917492.19	28.29	28.49	MW-QRY-03 G
15611	116795.20	917492.20	29.08	29.28	MW-QRY-03 C
15612	116795.19	917492.14	29.05	29.25	MW-QRY-03 P
15613	116782.99	917440.55	26.91	27.11	SG-QRY-02 3.0
15614	116721.40	917517.28	31.34	31.54	MW-QRY-02 G
15615	116721.38	917517.23	32.24	32.44	MW-QRY-02 C
15616	116721.40	917517.17	32.21	32.41	MW-QRY-02 P
15617	116734.22	917578.34	28.77	28.97	MW-QRY-04 G
15618	116734.34	917578.34	29.67	29.87	MW-QRY-04 C
15619	116734.31	917578.36	29.64	29.84	MW-QRY-04 P
15620	116724.79	917592.86	27.72	27.92	SG-QRY-01 3.0
15621	116668.13	917606.11	33.68	33.88	MW-QRY-01AG
15622	116668.11	917606.14	34.49	34.69	MW-QRY-01A C
15623	116668.20	917606.15	34.46	34.66	MW-QRY-01A P
15624	116667.63	917604.20	33.64	33.84	MW-QRY-018 G
15625	116667.57	917604.09	34.49	34.69	MW-QRY-018 C
15626	116667.66	917604.16	34.45	34.65	MW-QRY-018 P
15627	116748.97	917595.22	29.20	29.40	SPK/G GPS
15628	116794.71	917506.95	28.25	28.45	SPKIG GPS
15700	115293.35	919734.68	26.36	26.56	SPKIG
15701	115261.62	919620.13	25.62	25.82	SPKIG
15710	115283.31	919768.06	23.77	23.97	SG-12-01 3.0
15711	115337.01	919743.40	24.15	24.34	MW-12-03 G
15712	115336.92	919743.28	25.01	25.21	MW-12-03 C
15713	115337.06	919743.33	24.99	25.19	MW-12-03 P

01	
Sr	eet1

15714	115284.11	919682.56	23.75	23.95	MW-12-02 G
15715	115284.19	919682.51	24.56	24.76	MW-12-02 C
15716	115284.27	919682.56	24.54	24.74	MW-12-02 P
15717	115323.14	919651.36	22.84	23.04	MW-12-01 G
15718	115323.25	919651.36	23.68	23.88	MW-12-01 C
15719	115323.23	919651.43	23.65	23.85	MW-12-01 P

Sheet1

UTM ZONE 19 NAD83 (METERS)

NGVD Factor= 0.20

Point Number	Northina YI	Eastina XI	NGVD Factor= Elevation ZINAVD88	Elevation ZINGVD29	Descri tion
5440	4857911.03	425873.24	25.62	25.82	SPK
5441	4857941.13	425988.19	26.36	26.56	SPK
5445	4859426.35	423870.13	29.20	29.40	SPK
5446	4859473.31	423782.55	28.27	28.47	SPK
15600	4859480.54	423784.15	28.03	28.23	SPKIG
15601	4859409.10	423861.80	29.12	29.32	SPK/G
15602	4859384.22	423856.10	36.82	37.02	SPK/G
15610	4859473.96	423767.79	28.29	28.49	MW-QRY-03 G
15611	4859474.02	423767.80	29.08	29.28	MW-QRY-03 C
15612	4859474.01	423767.74	29.05	29.25	MW-QRY-03 P
15613	4859462.54	423716.00	26.91	27.11	SG-QRY-02 3.0
15614	4859399.89	423791.83	31.34	31.54	MW-QRY-02 G
15615	4859399.88	423791.78	32.24	32.44	MW-QRY-02 C
15616	4859399.90	423791.72	32.21	32.41	MW-QRY-02 P
15617	4859411.85	423853.04	28.77	28.97	MW-QRY-04 G
15618	4859411.97	423853.05	29.67	29.87	MW-QRY-04 C
15619	4859411.94	423853.07	29.64	29.84	MW-QRY-04 P
15620	4859402.22	423867.43	27.72	27.92	SG-QRY-01 3.0
15621	4859345.39	423879.87	33.68	33.88	MW-QRY-01A G
15622	4859345.37	423879.90	34.49	34.69	MW-QRY-01A C
15623	4859345.47	423879.92	34.46	34.66	MW-QRY-01A P
15624	4859344.92	423877.95	33.64	33.84	MW-QRY-018 G
15625	4859344.86	423877.85	34.49	34.69	MW-QRY-018 C
15626	4859344.95	423877.92	34.45	34.65	MW-QRY-018 P
15627	4859426.35	423870.13	29.20	29.40	SPKIG GPS
15628	4859473.32	423782.54	28.25	28.45	SPKIG GPS
15700	4857941.13	425988.19	26.36	26.56	SPKIG
15701	4857911.03	425873.24	25.62	25.82	SPKIG
15710	4857930.62	426021.42	23.77	23.97	SG-12-01 3.0
15711	4857984.65	425997.53	24.15	24.34	MW-12-03 G
15712	4857984.57	425997.40	25.01	25.21	MW-12-03 C
15713	4857984.71	425997.46	24.99	25.19	MW-12-03 P

				Sheet1	
15714	4857932.63	425935.97	23.75	23.95	MW-12-02 G
15715	4857932.71	425935.92	24.56	24.76	MW-12-02 C
15716	4857932.79	425935.97	24.54	24.74	MW-12-02 P
15717	4857972.08	425905.32	22.84	23.04	MW-12-01 G
15718	4857972.19	425905.32	23.68	23.88	MW-12-01 C
15719	4857972.18	425905.40	23.65	23.85	MW-12-01 P

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Tetra Tech Job No. 112G00645-CTO 69 Navy Contract No. N62472-03-D-0057 Subcontract No. 1100380

Monitoring Well and Fence Gate Locations Quarry Area

Dec. 3, 2013

Horizontal coordinates are MSPCS NAD83 West Zone, U.S. Survey Feet Elevations are NAVD88, in feet

Monitoring Wells

Tetra Tech Pt. ID	Easting	Northing	Ground Elev.	Top of PVC Riser	Top of Casing	Spivey Pt. Nos.
MW QRY-05	3010539.42	383138.10	94.65	97.24	97.42	504-506
MW QRY-06	3010307.02	382827.17	106.61	109.29	109.51	490-492
MW QRY-07	3010823.51	382941.05	90.91	93.44	93.56	487-489
MW QRY-08	3010784.98	382758.64	99.71	102.43	102.59	484-486
MW QRY-09	3010007.83	382991.82	94.15	96.34	96.53	493-495
MW QRY-10	3009995.52	383456.78	89.33	91.60	91.74	507-509
MW QRY-11	3010200.63	383452.27	91.55	93.97	94.16	510-512
MW QRY-12	3010365.26	383099.11	90.28	92.77	92.86	501-503

Fence Gate

Description	Easting	Northing	Ground Elev.	Spivey Pt. No.
West End	3010083.1	383213.5	91.7	496
East End	3010102.7	383209.0	91.7	497

APPENDIX D

HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The following risk assessment work plan was prepared to support the Quarry Area Remedial Investigation at the former Naval Air Station (NAS) Brunswick, Brunswick, Maine. This work plan provides the human health risk assessment (HHRA) protocol that will be used to evaluate chemical concentrations in soil, groundwater, surface water, and sediment at the Quarry Area. Risk assessments will be performed to evaluate whether chemical constituents at the site pose potentially unacceptable human health risks to exposed receptors under current and hypothetical future land use. Chemicals in the soil, groundwater, surface water, and sediment matrices, exposure pathways, and receptors will be evaluated to characterize the types and range of potential risks associated with site-related contamination.

1.0 HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The overall objective of the HHRA is to determine the potential for health risks in the absence of remedial action at the site and, if action is required, to focus the risk evaluation of remedial alternatives (RERA).

The following risk assessment guidance documents were used to develop the HHRA methodology:

- Department of Defense (DoD) Vapor Intrusion Handbook (DoD, 2009).
- Conducting Human Health Risk Assessments Under the Environmental Restoration Program,
 Chief of Naval Operations (N45) 5090 Ser N453E/1U595168, Feb 12, 2001 (Navy, 2001).
- Navy Policy on the Use of Background Chemical Levels, Chief of Naval Operations 5090 Ser N45C/N4U732212, Jan 30, 2004. (Navy, 2004).
- U.S. Navy Human Health Risk Assessment Guidance. (Navy, 2008).
 http://www.med.navy.mil/sites/nmcphc/Documents/environmental-programs/risk-assessment/Chapters_1-12.pdf.
- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1989).
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors.
 Washington, D.C. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03 (USEPA, 1991).

- Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C. (USEPA, 1993a).
- Guidance for Human Health Risk Assessments for Hazardous Substance Sites in Maine. State
 of Maine Department of Environmental Protection and Center for Disease Control (MEDEP,
 2011).
- Remediation Guidelines for Petroleum Contaminated Sites in Maine. Maine Department of Environmental Protection Bureau of Remediation and Waste Management (MEDEP, 2014).
- Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response, Washington, D.C. EPA/540/R-95/128 (USEPA, 1996).
- Risk Assessment Guidance for Superfund: Volume 1 Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments) (USEPA, 2001a).
- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response, Washington, D.C. OSWER 9285.6-10 (USEPA, 2002a).
- OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance). EPA 530-D-02-004 (USEPA, 2002b).
- Review of the Draft 2002 Subsurface Vapor Intrusion Guidance.
 http://www.epa.gov/oswer/vaporintrusion/documents/review of 2002 draft vi guidance final.pdf
 (USEPA, 2010a).
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA/540/R/99/005, OSWER 9285.7-02EP; PB99-963312 (USEPA, 2004).
- Guidelines for Carcinogen Risk Assessment. Risk Assessment Forum, Washington, D.C. EPA/630/P-03/001B. (USEPA, March 2005).

- Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens.
 Risk Assessment Forum, Washington, D.C. EPA/630/R-03/003F (USEPA, March 2005).
- Child-Specific Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C. EPA/600/R-06/096F (USEPA, 2008).
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA, 2009a).
- Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C.
 EPA/600/R-090/052F (USEPA, 2011).
- Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors (USEPA, 2014).
- Vapor Intrusion Evaluation Guidance.
 http://www.maine.gov/dep/spills/publications/guidance/index.html (MEDEP, January 2010).

The HHRA will be comprised of the following components:

- Data Evaluation Protocol
- Exposure Assessment
- Toxicity assessment
- Risk Characterization
- Uncertainty Analysis
- Derivation of Cleanup Goals

The HHRA will be structured and reported according to the guidelines of the Risk Assessment for Superfund (RAGS), Human Health Evaluation Manual, Part D: Standardized Planning, Reporting, and Review of Superfund Risk Assessments (RAGS Part D).

1.1 Data Evaluation

Data evaluation, the first component of a baseline HHRA, is a two-step, media-specific task involving the compilation and evaluation of analytical data. The first step involves the compilation of the analytical database and an evaluation of data usability for purposes of the HHRA. Soil samples collected during the 2010 MEC exploratory investigation of the site will be included with the RI sample results as one combined data set. For groundwater, the more comprehensive and more recent 2013 data set

associated with 13 site monitoring wells will be used for the HHRA. A semi-quantitative evaluation (e.g., risk ratio technique) of the less comprehensive and older data set associated with 4 of the monitoring wells in place in 2012 will also be included.

The second step of the data evaluation is the selection of a medium-specific list of chemicals of potential concern (COPCs), which will be used to quantitatively or qualitatively determine potential human health risks for site media. COPCs are selected based on a toxicity screen (a comparison of site contaminant concentrations to conservative screening concentrations) and a background screen (a comparison of site concentrations to background concentrations such as those in the Background Study Report for Naval Air Station Brunswick, [Tetra Tech, 2012]). Both a cumulative (i.e., risks from all chemicals including those within background) and site-specific (i.e., risks from site-related chemicals) risk assessment will be performed.

An "exposure unit" (EU) is the area over which receptor activity is expected to occur. The two most important considerations in defining an EU are the anticipated receptor activity and the spatial distribution of contaminant concentrations. The methodology for determining EUs is discussed in Section 1.2.3.

1.1.1 <u>Toxicity Screen</u>

COPCs for the site will be selected via the direct contact pathway (i.e., inhalation, dermal contact, and ingestion), groundwater protection soil screening levels (SSLs), and the indoor air (vapor intrusion) pathway.

Direct Contact Pathway Evaluation

USEPA Regional Screening Levels (RSLs) for residential soil and tapwater will be used to select COPCs for the direct contact exposure pathway with soil and groundwater, respectively, with the exception of the extractable petroleum hydrocarbon (EPH) and volatile petroleum hydrocarbon (VPH) fractions. EPH and VPH results will be compared to criteria specified in Worksheet #15 of this SAP because USEPA RSLs were not developed for those compounds. Initially surface water and sediment data will be screened for COPC selection against tapwater RSLs and residential soil RSLs, respectively; however, site-specific surface water and sediment screening values may be developed. The USEPA RSL concentrations and EPH and VPH screening concentrations are based on exposure pathways for which generally accepted methods, models, and assumptions have been developed (i.e., ingestion, dermal contact, and inhalation) for specific land-use conditions. The risk-based screening concentrations will correspond to a systemic hazard quotient (HQ) of 0.1 for noncarcinogens or an incremental lifetime cancer risk of 1 x10⁻⁶ for carcinogens. The USEPA RSLs for noncarcinogens are based on a HQ of 1.0, whereas the screening

concentrations will be based on an HQ of 0.1 to account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse non-carcinogenic effect.

Migration to Groundwater Pathway Evaluation

USEPA groundwater protection risk-based SSLs will be compared to maximum detected site soil concentrations for the selection of COPCs. The risk-based SSLs for groundwater protection are based on a dilution attenuation factor (DAF) of 1, which is the lowest DAF value possible and assumes that no reduction in concentration occurs as the contaminant moves from the source to groundwater, or in other words, that the concentrations at the source and in groundwater are the same (i.e., a receptor is exposed to the leachate concentration). If COPCs are selected for the migration to groundwater pathway, a qualitative evaluation will be used to further evaluate the COPCs. The qualitative evaluation will consider magnitudes of COPC concentrations, frequency of criteria exceedances, and whether COPC concentrations exceed groundwater protection SSLs based on a DAF of 20, which is generally assumed to be more accurate at most sites, or Maximum Contaminant Level (MCL-based) SSLs. Additionally, site-specific groundwater data will be evaluated to determine whether or not contaminants exceeding SSLs, if any, are actually present in groundwater. If a contaminant exceeds an SSL but is not present in groundwater professional judgment based on additional site-specific considerations (e.g., soil type) will be used to determine whether site data indicate that such a contaminant is actually leaching from soil to groundwater.

Vapor Intrusion Pathway Evaluation

Potential vapor intrusion (VI) sources in soil and groundwater will be investigated with consideration of current USEPA Vapor Intrusion Guidance (USEPA, 2002b, 2010a), Department of Defense Vapor Intrusion Handbook (DoD, 2009), and Maine Department of Environmental Protection (MEDEP) Vapor Intrusion Guidance (MEDEP, 2010).

The primary VI screening will be a comparison of detected groundwater concentrations to screening levels in the USEPA Vapor Intrusion Screening Level (VISL) Calculator. The values correspond to a target cancer risk level of 1 x 10⁻⁶ or a HQ of 0.1 for carcinogens and noncarcinogens, respectively. The VI screening levels were derived to identify chemical concentrations in groundwater that may adversely affect the indoor air quality of a building overlying subsurface volatile organic compound (VOC) contamination. The VI screening levels assume a subsurface attenuation factor of 0.001 from groundwater concentrations to indoor air concentrations.

No vapor intrusion screening criteria are available for soil. Therefore, COPC selection for vapor intrusion will not be performed for soil media. Instead, the potential for vapor intrusion sources will be evaluated qualitatively. Chemicals detected in soil will first be evaluated to determine if they are of sufficient volatility and toxicity to pose a VI concern. The USEPA VISL calculator will be consulted to determine if detected chemicals in soil were both 1) sufficiently volatile and 2) sufficiently toxic via inhalation (i.e., if inhalation toxicity criteria are available) to pose a vapor intrusion risk. If positive detections of a contaminant of sufficient volatility and toxicity to pose a VI concern exist, then the magnitude and frequency of those detections will be evaluated to qualitatively determine if a VI source may exist. Finally, if a qualitative evaluation of chemical data provides evidence that a VI source exists, then the concentrations of contaminants contributing to the VI source will be plotted on a map of the site (e.g., tag map) to further evaluate whether or not a VI source may exist. The RI report will provide recommendations for whether or not further investigation of potential VI soil sources is warranted.

1.1.2 <u>Background Screen</u>

Background data will be used to screen out detected chemicals within site background concentrations to identify site-related chemicals and site-related risks. Background concentrations are concentrations that would exist in the absence of influence from site operations. A background screening will be conducted for all chemicals included in the COPC screening process (i.e., chemicals yielding detections), as discussed herein. Site data will be compared to background using lines-of-evidence such as site-specific facility background data for applicable metals, pesticides, and PAHs or the MEDEP background PAH values which are included in Maine's Remedial Action Guidelines (RAGs) Appendix 1 and 2 tables (MEDEP, 2013). For PAHs, the site-specific facility background data represents natural rather than anthropogenic conditions and so available facility background values may be used for portions of the Quarry site while for other portions of the Quarry site comparisons to Maine's Rural Developed category for PAHs may be considered instead.

Several categories of facility background data are available. The facility background categories that will be used to match the varied site conditions, based on investigation results to date and to be refined following evaluation of the RI lithology data, where the munitions response site (MRS) is defined as the original Preliminary Assessment (PA) site boundary central to the site, are as follows:

For soil:

- "Mixed Soil" for surface and subsurface soil within the Quarry/MRS boundary
- "Mixed Soil" for surface soils between MRS and Old Route 24 and east of the MRS
- "Upper Sand" for subsurface soils between MRS and Old Route 24

- "Upper Sand" for surface and subsurface soils south of Old Route 24 and north of Radio Tower
 Access Road
- For subsurface soils east of the MRS, the background category will be dependent on what is encountered. It may be clay (Presumpscot) or sand. There is no UPL for the Presumpscot clay, so it is assumed that the default "Transition Unit" will be used. "Upper Sand" would be used if sand is encountered.

It is recognized that a few samples within each area could individually have a differing designation than the overall given area. If these samples differing in soil type from the overall area have concentrations that exceed both background and maximum concentration for the remainder of the area, the data will be further evaluated to determine whether the chemical concentration is greater than background for that area. Otherwise, these samples will be designated as part of the area as a whole and screened against background for that area.

For groundwater, background categories can be classified by area: the wells in the northeastern portion of the site would fall under "Upper Sand Fall/Spring", whereas the rest of the site would be "Bedrock Fall/Spring". Specifically,

- "Upper Sand Spring" or "Upper Sand Fall" would apply to wells MW-QRY-03, -09, -10, & -11
- "Bedrock Spring" or "Bedrock Fall" would be apply to all other wells (MW-QRY-01A/B, -02, 04, -05, -06, -07, -08, & -12).

To date, both sets of groundwater data were collected in the Fall.

Total risks (site plus background) will be presented separately for informational purposes.

1.1.3 Selection of COPCs

The COPC selection process is as follows:

- **Step 1:** The maximum detected concentration of an analyte will be compared to screening values. If the maximum detected sample concentration is less than the screening value, the parameter is not retained for quantitative risk assessment. Additionally, essential nutrients (i.e., calcium, magnesium, potassium, and sodium) are not selected as COPCs.
- **Step 2**: A constituent detected at concentrations less than background will not be identified as a COPC and will not be included in risk estimates calculated in the primary risk summary tables. Chemicals will be selected as COPCs if the maximum detected concentration for a given matrix exceeds the associated screening and background values.

Because of the lack of toxicity criteria, risk-based COPC screening levels are not available for some chemicals (e.g., acenaphthylene, benzo(g,h,i)perylene, and phenanthrene). For these constituents, surrogate chemicals (which have toxicity criteria) will be used for screening purposes. For example, acenaphthene will be used as a surrogate for acenaphthylene, and pyrene will be used as a surrogate for benzo(g,h,i)perylene and phenanthrene.

The results of the COPC selection will be summarized in tables prepared according to RAGS Part D guidance (RAGS Part D Table 2). The rationale for the inclusion or exclusion of chemicals as COPCs will be clearly presented.

1.2 Exposure Assessment Protocol

The exposure assessment component of a baseline HHRA defines and provides a means to evaluate, quantitatively or qualitatively, the type and magnitude of human exposure to chemicals present at or migrating from a site. A foundation of the exposure assessment is the conceptual site model (CSM), which identifies site characteristics including potential contaminant sources, contaminant release mechanisms, transport routes, receptors, and other appropriate information. The CSM must consider both current and future land use scenarios and integrates information regarding the physical characteristics of the site, exposed populations, sources of contamination, and contaminant mobility (fate and transport) to identify potential exposure routes and receptors evaluated in the risk assessment. A well-defined CSM allows for a better understanding of the risks at a site and aids risk managers in the identification of the potential need for remediation.

1.2.1 Conceptual Site Model

Sources of Contamination

Undocumented and an undetermined amount of munitions disposal, detonation, and training activity occurred at the Quarry Area that is a potential source of soil, groundwater, surface water, and sediment contamination including munitions constituents (MC) from discarded munitions. In addition, quarrying, land-farming, and disposal of construction debris also appear to have occurred at the site. A few empty drums present on the ground surface suggest that other hazardous constituents may also be present. Therefore, environmental media will be sampled for a full suite of Comprehensive Environmental Response Compensation and Liability Act (CERCLA) contaminants (e.g. Target Analyte List (TAL) metals, and Target Compound List (TCL) volatile and semi-volatile organic compounds, pesticides, and polychlorinated biphenyls [PCBs]) to determine if hazardous wastes are present except where only munitions activities occurred (i.e., kickout area) in which case a more limited analytical suite consisting of explosives (including nitroglycerin) and TAL metals is adequate.

Potential Contaminant Migration Mechanisms

Potential contaminant migration pathways include dissolution and migration from soil to groundwater, erosion and overland runoff, and VI.

Dissolution of contaminants associated with the Quarry Area in infiltrating precipitation with subsequent lateral migration will be investigated to determine if that is a significant migration pathway. Potential migration via dissolution from precipitation and subsequent lateral migration will be evaluated using SSLs as described in Section 1.1.1.

Erosion and overland runoff are potential migration mechanisms if contaminants are exposed. Fine-grained soils such as clays tend to accumulate a greater mass of chemical contaminants than large-grained soils, such as sand, and tend to be transported via overland runoff to lower elevations during rain events. If contaminated matrices (soils) are uncovered, contaminant transport of dissolved and suspended particulates in overland runoff would occur at the rate of overland flow. Overland flow particles could eventually enter stream or pond surface water and settle into stream or pond sediments if this potential transport mechanism occurred.

Potential VI sources in soil will be investigated as described in Section 1.1.1.

Land Uses and Potential Exposure

The Quarry Area has been used for the quarrying, land-farming, suspected disposal, training, and detonation of munitions, and disposal of construction debris. On May 31, 2011 NAS Brunswick was disestablished and potential future land use is anticipated as College Use Conservation District (Education/Natural Area and/or education/mixed use space – south of Old Route 24) and is expected to be used by the general public for low-intensity activities such as bird watching, hiking, and educational purposes.

1.2.2 <u>Human Health Receptors</u>

Following is a discussion of the potential human health receptors. Currently potential human receptors include occupational workers, construction workers, and trespassers. Future potential human receptors include residents, occupational workers, construction workers, and recreational users. Future residential use of the site is not currently planned; however, hypothetical future residential use is evaluated as a risk scenario that could occur if the sites were developed for residential use.

Current and Future Occupational Workers – an onsite receptor under current or future land use. Occupational workers could be exposed to contamination in surface soil via incidental ingestion, dermal contact, and air (inhalation). Receptor exposure to subsurface soil would only occur if subsurface soils were excavated and deposited on existing surface soils. If this receptor were to work in an on-site structure, this receptor could be exposed to VOCs migrating to the indoor air of a building from contaminated subsurface soil or groundwater via vapor intrusion.

Current and Future Construction Workers – an onsite receptor under current or future land use. Construction workers could be exposed to contamination in surface and subsurface soil via incidental ingestion, dermal contact, and air (inhalation), surface water and sediment (while wading) via incidental ingestion and dermal contact, and groundwater via incidental ingestion, dermal contact, and air (inhalation).

Current Trespassers (Adolescents and Adults) – an onsite receptor under current land use who may spend time outdoors recreating (e.g., walking, playing sports). A trespasser may be exposed to surface soil via incidental ingestion, dermal contact, and inhalation or surface water and sediment (while wading) via incidental ingestion and dermal contact. Trespasser exposure to subsurface soil would only occur if subsurface soils were excavated and deposited on existing surface soils.

Future Recreational Users (Children and Adults) – an onsite receptor under future land use who may spend time outdoors recreating (e.g., walking, playing sports). A recreational user may be exposed to surface soil via incidental ingestion, dermal contact, and inhalation or surface water and sediment (while wading) via incidental ingestion and dermal contact. Receptor exposure to subsurface soil would only occur if subsurface soils were excavated and deposited on existing surface soils.

Hypothetical Future Residents (Children and Adults) – Future child and adult residents, assuming the land use is changed to residential. The hypothetical future resident is expected to be exposed to surface soil by incidental ingestion, dermal contact, and inhalation assuming that soil is uncovered (no grass or asphalt). A future hypothetical resident may also be exposed to groundwater via ingestion, dermal contact, and inhalation if the groundwater was used as a drinking water source. The hypothetical future resident could be exposed to surface water and sediment (while wading) via incidental ingestion and dermal contact in the seasonal drainage areas at the Quarry Area. Receptor exposure to subsurface soil would only occur if subsurface soils were excavated and deposited on existing surface soils. Hypothetical residents could also be exposed via inhalation to VOCs migrating to the indoor air of a home from contaminated subsurface soil or groundwater via vapor intrusion.

1.2.3 <u>Calculation of Exposure Point Concentrations</u>

The exposure point concentration (EPC), which is calculated for COPCs only, is an estimate of the chemical concentrations within an exposure unit likely to be contacted over time by a receptor and is used to estimate exposure intakes. The following paragraphs discuss the relationship between the terms "site" and EU in reference to calculating the EPC and the guidelines for calculating the EPC.

An EU is the area over which receptor activity is expected to occur. The two most important considerations in defining an EU are the anticipated receptor activity and the spatial distribution of contaminant concentrations. Exposure units will be determined following data collection by comparing chemical concentration distributions in decision units (DUs) to each other to determine whether or not DUs with similar chemical distributions can be combined. If chemical data from any give DU cannot be combined with another DU to form an EU than that DU will be evaluated as an individual EU.

To determine if COPC between DUs are similar side by side box plots will be utilized. Box plots show the central tendency, degree of symmetry, range of variation, and potential outliers of a dataset. The dataset is shown as a rectangular box that represents the middle 50 percent of the data. The upper value of the box represents the 75th percentile and the lower value of the box represents the 25th percentile. The median is represented by the middle line in the box. Box plots for the same analyte in the two datasets will be plotted on the same graph. Whiskers will be drawn from the box extending outward to 1.5 times the interquartile range (difference between 75th and 25th percentiles). Concentrations that are less than the lower whisker and greater than the upper whisker are potential outliers and will be plotted as circles. If the median concentration of a given chemical in one DU falls below the 75th percent and above the 25th percentile of that same chemical in another DU the chemical concentrations in the two DUs will be considered similar.

The available data sets for the site will be evaluated to assure that the data are adequate and acceptable for risk assessment (i.e., there are no data gaps) prior to the calculation of EPCs. If the data sets are found to be inadequate, the project stakeholders (Navy, USEPA, MEDEP) will discuss and agree how to proceed.

EPCs will be determined as follows; sample and duplicate analytical results will be averaged:

• For soil, groundwater, surface water, and sediment data sets containing at least five samples, the 95-percent upper confidence limit (UCL) on the arithmetic mean, which is based on the distribution of the data set, will be selected as the EPC unless the UCL exceeds the maximum detected concentration or there are an insufficient number of detections in a data set (i.e., less than four), in accordance with USEPA ProUCL guidance (2013). EPCs will be calculated

- following USEPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (2002c) and using USEPA's ProUCL Version 5.0.00 (2013).
- If lead is selected as a COPC, the mean lead concentration for each data set will represent the EPC for lead.

1.2.4 Chemical and Intake Estimation

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The most recent USEPA and MEDEP guidance (e.g., the Exposure Factors Handbook [USEPA, 2011] and Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors [USEPA, 2014] and Maine's Guidance for Human Health Risk Assessments for Hazardous Substance Sites in Maine [MEDEP, 2009]) will be used to estimate intakes. In general, standard default parameters, which combine mid-range and upper-end exposure factors, will be used to assess exposures; however, site specific parameters will be utilized when applicable. The equations and exposure parameters obtained from USEPA and MEDEP guidance documents that will be used to quantify intakes and intake parameters are summarized in the RAGS Part D Table 4s, provided in Attachment A.

Traditionally, exposures evaluated in the HHRA have been based on the concept of reasonable maximum exposure (RME), defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989a). However, more recent risk assessment guidance (USEPA, 1992), recommends addressing an average case, or Central Tendency Exposure (CTE). The available guidance concerning the evaluation of CTE (USEPA, 1993a) is limited; however, the CTE will be evaluated for each receptor to provide a greater perspective about site risks for risk managers than just the RME scenario alone.

USEPA's Supplemental Guidance for Assessing Susceptibility from Early Life Exposure to Carcinogens (2005b) recommends adjusting the toxicity of carcinogenic chemicals that act via the mutagenic mode of action when evaluating early-life exposures to contaminants. The guidance recommends using age-dependent adjustment factors (ADAFs) in concert with age-specific exposure estimates when assessing cancer risks. Absent chemical-specific data, the supplemental guidance recommends the following default adjustments, which reflect that cancer risks are generally higher from early-life exposures than from similar exposures later in life:

• For exposures before two years of age (i.e., spanning a two-year interval from the first day of birth until a child's second birthday), a 10-fold adjustment.

- For exposures between two and less than 16 years of age (i.e., spanning a 14-year time interval from a child's second birthday until a child's sixteenth birthday), a three-fold adjustment.
- For exposures after reaching 16 years of age, no adjustment.

These adjustments are applied using the same method as that used by USEPA to develop the RSLs. Children will be evaluated in two age groups, ages 0–2 and 2–6 years old. Adults will be evaluated as two age groups (6-16 and 16–26 years old). Using this approach, the intakes for child and adult recreational users and residents will be calculated as follows:

In addition, adolescent trespassers will be evaluated as one age group, 6–16 years old, and adult trespassers will be evaluated as one age group, 16–26 years old. Using this approach, the intakes for adolescent and adult trespassers will be calculated as follows:

This approach will be used only for the chemicals planned for analysis that are identified as mutagenic in the USEPA RSL table (e.g., benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene). calculations showing how this approach was applied will be included in an appendix to the HHRA. In addition, risks to lifelong trespassers, lifelong recreational users, and lifelong resident receptors will be evaluated. Risks to lifelong trespassers are the sum of the cancer risks for adolescent and adult trespassers, and risks to lifelong recreational users and lifelong residents are sums of the cancer risks calculated for individual children and adult receptors. Therefore, lifelong cancer risks from chemicals that act via the mutagenic pathway are assessed through the lifelong trespasser, lifelong recreational user, and lifelong resident receptor scenarios.

Lead (if selected as a residential COPC) will be evaluated using the USEPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for Lead in children Windows Version 1.1, Build 11 (USEPA, 2010b). Exposure of adults (workers and recreational users) to lead will be evaluated by the adult exposure model presented in the following USEPA document: Recommendations of the Technical Review Workgroup for

Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soils (USEPA, January 2003a). The following paragraphs provide a brief overview of these models.

The IEUBK model is recommended by USEPA for the evaluation of childhood lead exposures assuming a residential land use scenario. The IEUBK is designed to estimate blood-lead levels in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The results of the IEUBK modeling are given in terms of the probability that exposed children will exceed a 10 µg/dL blood-lead level. This probability is typically compared to the USEPA goal of limiting the risk of a child exceeding a 10 µg/dL blood-lead concentration to 5 percent. The 400 mg/kg USEPA RSL for lead for residential land use is based on the IEUBK model.

The USEPA Technical Review Workgroup (TRW) Adult Lead Model (ALM) focuses on assessing risks associated with non-residential adult exposures to lead in soils. The model was originally published to provide guidance on the calculation of soil clean-up levels based on protecting adults (specifically, women of childbearing age) using a conservative approach that relates the lead level in the environment with the blood-lead level of a developing fetus. The output of the model is the risk (i.e., the probability) that elevated fetal blood-lead concentrations (i.e., concentrations greater than 10 μ g/dL) will result due to exposures to women of childbearing age.

If the IEUBK model is run for lead, the input parameters other than the site arithmetic mean soil lead concentration will be USEPA default values. The IEUBK model output files, which include the default input parameters, will be included in an appendix to the HHRA. If the ALM is run for lead, the non-default input parameters to the ALM are the arithmetic mean soil lead concentration and receptor-specific ingestion rates and exposure frequencies, which are based on Central Tendency Exposure (CTE) exposure assumptions (included in the RAGS Part D Table 4s). The receptors evaluated by the ALM are non-residents. In this HHRA, the ALM would be used to evaluate lead exposures for construction workers, industrial workers, and adult recreational users. The receptor-specific input parameters will be in the model output files, which will be included in an appendix to the HHRA, and the receptor-specific input parameters will also be discussed in the text.

1.3 Toxicity Assessment

The objective of the toxicity assessment is to identify the potential adverse health effects in exposed populations. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified constituents of concern.

Quantitative toxicity values determined during this component of the risk assessment are integrated with outputs of the exposure assessment to characterize the potential for the occurrence of adverse health effects for each receptor group.

The reference dose (RfD) is the toxicity value used to evaluate non-carcinogenic health effects for ingestion and dermal exposures. The reference concentration (RfC) is used to evaluate non-carcinogenic health effects for inhalation exposures. The RfD and RfC estimate the daily exposure level for the human population that is likely to be without appreciable risk during a portion or all of a lifetime. Those are based on a review of available animal and/or human toxicity data, with adjustments for various uncertainties associated with the data. Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures, and using inhalation unit risks (IURs) for inhalation exposure that are plausible upper-bound estimates of the probability of development of cancer per unit intake of chemical over a lifetime. The probability is based on available dose-response data from human and/or animal studies.

1.3.1 Toxicity Criteria for Oral and Inhalation Exposures

Oral RfDs and CSFs and inhalation RfCs and IURs to be used in the site-specific risk assessments will be obtained from the following primary USEPA literature sources (USEPA, 2003b):

- Tier 1 Integrated Risk Information System (IRIS).
- Tier 2 USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical specific basis when requested by USEPA's Superfund program.
- Tier 3 Other Toxicity Values These sources include but are not limited to California Environmental Protection Agency (Cal EPA) toxicity values, the Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Levels (MRLs), and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

Although RfDs and CSFs can be found in several toxicological sources, USEPA's IRIS online database is the preferred source of toxicity values.

1.3.2 <u>Toxicity Criteria for Dermal Exposure</u>

RfDs and CSFs found in literature are typically expressed as administered (not absorbed) doses. Therefore, these values are considered to be inappropriate for estimating the risks associated with the dermal route of exposure. Oral dose-response parameters based on administered doses must be adjusted to absorbed doses before the comparison to estimated dermal exposure intakes is made.

The adjustment to an absorbed dose will be made using chemical-specific gastrointestinal absorption efficiencies published in USEPA dermal guidance (USEPA, 2004) using the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) / (ABS_{GI})$$

where: ABS_{GI} = absorption efficiency in the gastrointestinal tract

RfD_{dermal}= reference dose for the dermal route of exposure

 RfD_{oral} = reference dose for the oral route of exposure

CSF_{dermal}= cancer slope factor for the dermal route of exposure

CSF_{oral} = cancer slope factor for the oral route of exposure

As noted above, the preceding adjustment of the oral toxicity criteria is necessary so that the dermal route of exposure may be quantitatively evaluated in the baseline risk assessment. Explanations and the need for this procedure are presented in Appendix A of USEPA RAGS Part A (USEPA, 1989). The sources or rationale for ABS_{GI} values used in risk calculations will be documented in the HHRA if any COPCs lack published ABS_{GI} values in RAGS Part E.

1.4 Risk Characterization Protocol

Potential risks (non-carcinogenic and carcinogenic) for human receptors resulting from the potential exposures outlined in the exposure assessment are quantitatively determined during the risk characterization component of the HHRA. The quantitative estimates of risk are calculated in accordance with the risk assessment methods outlined in USEPA guidance (USEPA, 1989).

1.4.1 Quantitative Analysis of Chemicals

Quantitative estimates of risk for chemicals will be calculated according to risk assessment methods outlined in USEPA and MEDEP guidance (USEPA, 1989 and MEDEP, 2009). Lifetime cancer risks will

be expressed in the form of dimensionless probabilities, referred to as incremental lifetime cancer risks (ILCRs), based on CSFs. Non-carcinogenic risk estimates will be presented in the form of hazard quotients (HQs) that are determined through a comparison of intakes with published RfDs.

ILCR estimates for ingestion and dermal exposures are generated for each COPC using estimated exposure intakes and published CSFs, as follows:

ILCR = (Estimated Exposure Intake)(CSF)

Where:

ILCR = Incremental Lifetime Cancer Risk for a COPC (unitless)

Estimated Exposure Intake = oral or dermal chemical intake for a receptor [milligram per kilogram per day (mg/kg/day)]

CSF = oral or dermal cancer slope factor for a COPC (mg/kg/day)⁻¹

If the above equation results in an ILCR greater than 0.01, the following equation will be used:

ILCR = 1-[exp(-Estimated Exposure Intake)(CSF)]

ILCR estimates for inhalation exposures were generated for each COPC using estimated exposure concentrations and published IURs, as follows:

ILCR = [IUR][Exposure Concentration][1000 micrograms per milligram(µg/mg)]

Where:

IUR = inhalation unit risk for a COPC ($(\mu g/m^3)^{-1}$); where m^3 = meters cubed Exposure Concentration = inhalation chemical intake for a receptor (mg/m^3)

An ILCR of 1 x 10⁻⁶ indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million persons.

As mentioned previously, non-carcinogenic risks will be assessed using the concept of HQs and hazard indices (His). The HQ for a COPC is the ratio of the estimated intake to the RfD, as follows for ingestion and dermal exposures:

HQ = (Estimated Exposure Intake)/(RfD)

Where:

HQ = Hazard Quotient for a COPC (unitless)

Estimated Exposure Intake = oral or dermal chemical intake for a receptor (mg/kg/day)

RfD = inhalation reference dose for a COPC (mg/kg/day)

For inhalation exposures, HQ is calculated as follows:

HQ = (Exposure Concentration)/(RfC)

Where:

Exposure concentration = inhalation chemical intake for a receptor (mg/m³)

RfC = inhalation reference concentration for a COPC (mg/m³)

A hazard index (HI) will be generated by summing the individual HQs for all COPCs. The HI is not a mathematical prediction of the severity of toxic effects and is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of non-carcinogenic (threshold) effects.

1.4.2 <u>Interpretation of Risk Assessment Results</u>

To interpret the quantitative risk estimates and to aid risk managers in determining the need for remediation, quantitative risk estimates will be compared to typical USEPA and MEDEP risk benchmarks. Calculated ILCRs will be interpreted using the USEPA target range (1 x 10^{-6} to 1 x 10^{-4}) and State of Maine's risk benchmark (1 x 10^{-5}), and HIs will be evaluated using a value of 1.0 for target organs and critical effects. Current USEPA policy regarding lead exposures is to limit the risk of a child exceeding a 10 microgram per deciliter (μ g/dL) blood-lead level to 5 percent.

USEPA has defined the range of 1 x 10^{-6} to 1 x 10^{-4} as the ILCR target range for hazardous waste facilities addressed under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA). Individual or cumulative ILCRs greater than 1 x 10^{-4} are generally considered to be "unacceptable" by the USEPA. Risk management decisions are necessary when the ILCR is within 1 x 10^{-4} to 1 x 10^{-6} . Remediation is typically not required

by the USEPA when the cumulative ILCR does not exceed 1 x 10^{-6} . Similarly, cumulative ILCRs greater than 1 x 10^{-5} are generally considered to be "unacceptable" by the State of Maine.

An HI exceeding unity (1.0) for a target organ or critical effect indicates that there may be non-carcinogenic health risks associated with exposure. If an HI exceeds unity, target organ effects associated with exposure to COPCs are considered. Only those HQs for chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1.0, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect.

Lead is evaluated separately from other chemicals. The results of the IEUBK model and ALM model will be compared to the USEPA goal of limiting the risk of a child exceeding a 10 μ g/dL blood-lead concentration to 5 percent. If a model output indicates more than a 5 percent risk of a child exceeding a 10 μ g/dL blood-lead concentration of, the risk is typically considered unacceptable.

1.5 Human Health Risk Uncertainty Analysis

The baseline risk assessment will include an uncertainty analysis that qualitatively addresses major sources of uncertainty in the data evaluation, exposure assessment, toxicity assessment, and risk characterization. Probabilistic risk assessment techniques may be recommended to provide risk managers with a more comprehensive understanding of the uncertainty associated with the quantitative risk assessment results. The following subsections present an overview of uncertainties that may be addressed in a site-specific risk assessment uncertainty section.

1.5.1 <u>Uncertainty in Data Evaluation</u>

This section may discuss uncertainties in the risk assessment associated with the analytical data and data quality. This may also involve a discussion of uncertainty in the COPC selection process, the inclusion or exclusion of COPCs in the risk assessment on the basis of background concentrations, the uncertainty in COPC screening levels, uncertainty associated with non-detected results that exceed the screening criteria, and the omission of constituents for which health criteria are not available.

1.5.2 Uncertainty in the Exposure Assessment

This section will include a discussion of the following: assumptions related to current and future land use; the uncertainty in EPCs (e.g., the use of maximum concentrations to estimate risks); uncertainty in the selection of potential receptors and exposure scenarios; and uncertainty in the selection of exposure

parameters (RME vs. CTE). If predictive models are used in the risk estimation, the uncertainty associated with the model and modeling parameters will be evaluated.

1.5.3 Uncertainty in the Toxicity Assessment

The uncertainties inherent in RfDs and CSFs and use of available criteria will be discussed. A discussion of the uncertainty in hazard assessment, which deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans, will be provided. This section will also discuss uncertainty in the dose-response evaluations for the COPCs, which relates to the determination of a CSF for the carcinogenic assessment and derivation of an RfD for the non-carcinogenic assessment. If there are any considerable differences between the toxicity criteria used in the HHRA and the criteria recommended in Maine guidance (MEDEP, 2011), those differences will be discussed qualitatively.

1.5.4 <u>Uncertainty in the Risk Characterization</u>

This section will discuss the uncertainty in risk characterization which results primarily from assumptions made regarding additivity/synergism of effects from exposure to multiple COPCs affecting different target organs across various exposure routes. The risk assessment will discuss the uncertainty inherent in summing risks for several substances across different exposure pathways. It should be noted that probabilistic risk assessment techniques may also be recommended to further define the uncertainty attached to the risk characterization results. However, the exposure assumptions (e.g., probability distributions) used to prepare the probabilistic risk assessment, if necessary, will be reviewed with the regulatory reviewers before they are incorporated into the uncertainty section of the baseline risk assessment.

REFERENCES

DoD (Department of Defense), 2009. DoD Vapor Intrusion Handbook. Prepared by the Tri-Service Environmental Risk Assessment Workgroup.

MEDEP, 2010. Vapor Intrusion Evaluation Guidance. Maine Department of Environmental Protection, Bureau of Remediation. January 13. http://www.maine.gov/dep/spills/publications/guidance/index.html

MEDEP, 2011. Guidance for Human Health Risk Assessments for Hazardous Substance Sites in Maine. State of Maine Department of Environmental Protection and Center for Disease Control. February.

MEDEP, 2013. Maine Remedial Action Guidelines (RAGs) for Sites Contaminated with Hazardous Substances. Maine Department of Environmental Protection Bureau of Remediation and Waste Management. May 8.

MEDEP, 2014. Remediation Guidelines for Petroleum Contaminated Sites in Maine. Maine Department of Environmental Protection Bureau of Remediation and Waste Management. May.

Navy, 2001. Conducting Human Health Risk Assessments Under the Environmental Restoration Program, Chief of Naval Operations (N45) 5090 Ser N453E/1U595168.

Navy, 2002. Guidance for Environmental Background Analysis Volume 1: Soil, Naval Facilities Engineering Command (NFESC) User's Guide, UG-2049-ENV, prepared by Battelle Memorial Institute, Earth Tech, Inc, NewFields, Inc. Washington D.C. April.

Navy, 2004. Navy Final Policy on the Use of Background Chemical Levels, Chief of Naval Operations (N45) 5090 Ser N45C/N4U732212. January.

Navy, 2008. U.S. Navy Human Health Risk Assessment Guidance. http://www.med.navy.mil/sites/nmcphc/Documents/environmental-programs/risk-assessment/Chapters_1-12.pdf December.

Navy, 2011 Navy Human Health Risk Assessment Webpage: http://www-nehc.med.navy.mil/hhra/.

Tetra Tech, 2011. Site Inspection Report for Munitions Response Program Sites - Machine Gun Bore Range Site - Skeet Range, Former Naval Air Station Brunswick, Brunswick, Maine. King of Prussia, PA.

Tetra Tech, 2012. Background Study Report for Naval Air Station Brunswick, March.

USEPA, 1989. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A)

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure <u>Factors</u>. Washington, D.C. Office of Solid Waste and Emergency Response (OSWER) Directive 9285.6-03

USEPA, 1992. Guidance and Risk Characterization for Risk Managers and Risk Assessors. Memorandum from F. Henry Habicht, Deputy Administrator, Washington, D.C.

USEPA, 1993a. Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure. Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA, 1996. Soil Screening Guidance: Technical Background Document. Office of Solid Waste and Emergency Response, Washington, D.C. EPA/540/R-95/128.

USEPA, 1997b. Health Effects Assessment Summary Tables FY 1997. Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA, 2001a. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments)

USEPA, 2001b. Guidance for Characterizing Background Chemicals in Soil at Superfund Sites. USEPA OSWER. Office of Emergency Response and Remedial Response (OERR) and OSWER 9285.7-41, EPA 540-R-01-003

USEPA, 2002a. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response, Washington, D.C. OSWER 9285.6-10

USEPA 2002b. USEPA Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils. Office of Emergency and Remedial Response, Washington, D.C. EPA530-D-02-004

USEPA, 2003a. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. USEPA. Washington, DC. EPA-540-R-03-001. [URL: http://www.epa.gov/superfund/programs/lead/adult.htm].

USEPA, 2003b. Human Health Toxicity Values in Superfund Risk Assessments. Office of Superfund Remediation and Technology Innovation, OSWER 9285.7-53, Washington, DC.

USEPA, 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA/540/R/99/005, OSWER 9285.7-02EP; PB99-963312

USEPA, 2005a. Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/001B. Risk Assessment Forum, Washington, DC.

USEPA, 2005b. Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens. EPA/630/R-03/003F. Risk Assessment Forum, Washington, DC.

USEPA, 2008. Child-Specific Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C. EPA/600/R-06/096F.

USEPA, 2009a. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final. Office of Superfund Remediation and Technology Innovation, Washington, D.C. 20460 EPA-540-R-070-002, OSWER 9285.7-82. USEPA, 2010a. PROUCL Version 4.1.00 User Guide, EPA/600/R-07/041.

USPEA, 2010a. Review of the Draft 2002 Subsurface Vapor Intrusion Guidance. http://www.epa.gov/oswer/vaporintrusion/documents/review of 2002 draft vi guidance final.pdf USEPA, 2011. Exposure Factors Handbook. Office of Health and Environmental Assessment, Washington, D.C. EPA/600/R-90/052F

USEPA, 2010b. Integrated Exposure Uptake Biokinetic Model for Lead in Children, Windows version (IEUBKwin v 1.1 Build 11).

USEPA, 2013. ProUCL Version 5.0.00 User Guide. Office of Research and Development, Washington, D.C. EPA/600/R 07/041. September.

USEPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid Waste and Emergency Response, Washington, D.C. OSWER 9200.1-120. February 6.

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS- SOILS NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	250	days/year	MEDEP, 2009	
				ED	Exposure Duration	1	years	USEPA, 2002b	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	3470	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	MEDEP, 2009	
				ED	Exposure Duration	1	years	MEDEP, 2009	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	

Notes

1 - Professional judgment.

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.04E-08

Cancer Dermal Intake = 1.27E-07

Noncancer Ingestion Intake = 2.83E-06

Noncancer Dermal Intake = 8.91E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	165	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	150	days/year	(1)	
				ED	Exposure Duration	1	years	USEPA, 2002b	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	3470	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	150	days/year	(1)	
				ED	Exposure Duration	1	years	USEPA, 2002b	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

 $USEPA, 2014: Human\ Health\ Evaluation\ Manual,\ Supplement\ Guidance,\ Update\ of\ Standard\ Default\ Exposure\ Factors.\ OSWER\ 9200.1-120.$

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.21E-08

Cancer Dermal Intake = 2.55E-08

Noncancer Ingestion Intake = 8.48E-07

Noncancer Dermal Intake = 1.78E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - SOILS TO AIR $% \left(1\right) =\left(1\right) \left(1\right) \left$

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	MEDEP, 2009	CA x ET x EF x ED
				EF	Exposure Frequency	250	days/year	MEDEP, 2009	AT x 24 hours/day
				ED	Exposure Duration	1	years	USEPA, 2002b	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	
				PEF	Particulate Emission Factor	1.43E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 3.26E-03

Noncancer Inhalation Intake = 2.28E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	MEDEP, 2009	CA x ET x EF x ED
				EF	Exposure Frequency	150	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	1	years	USEPA, 2002b	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	
				PEF	Particulate Emission Factor	1.43E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.96E-03

Noncancer Inhalation Intake = 1.37E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug		
				IR-GW	Ingestion Rate of Groundwater	0.05	L/day	(1)	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	26	days/year	MEDEP, 2011	BW x AT
				ED	Exposure Duration	0.5	years	MEDEP, 2011	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/L	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3470	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	MEDEP, 2011	For organics if tevent > t*
				ED	Exposure Duration	0.5	years	MEDEP, 2011	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	

^{1 -} Professional judgment. Assumes construction workers are only exposed to groundwater during part of the construction project.

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2004: Risk \ Assessment \ Guidance \ for \ Superfund \ (Part \ E, \ Supplemental \ Guidance \ for \ Dermal \ Risk \ Assessment) \ Final. \ EPA/540/R/99/005.$

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Dermal Intake = $(SA \times EV \times EF \times ED)/(BW \times AT)$

Cancer Dermal Intake = 2.21E-02

Noncancer Dermal Intake = 3.09E+00

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 2002a	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug		
				IR-GW	Ingestion Rate of Groundwater	0.025	L/day	(1)	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	15	days/year	(1)	BW x AT
				ED	Exposure Duration	0.5	years	MEDEP, 2011	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/L	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3470	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	15	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	0.5	years	MEDEP, 2011	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	

^{1 -} Professional judgment. Assumes construction workers are only exposed to groundwater during part of the construction project. For some factors, CTE is assumed to be 50 percent of RME.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Dermal Intake = 1.27E-02

Noncancer Dermal Intake = 1.78E+00

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor
Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER TO AIR NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2012	Exposure Concentration (mg/m³) =
				CW	Chemical concentration in water	Max or 95% UCL	ug/L		
				CF	Conversion Factor	0.001	mg/ug		<u>CA x ET x EF x ED</u>
				ET	Exposure Time	4	hours/day	(1)	AT x 24 hours/day
				EF	Exposure Frequency	26	days/year	MEDEP, 2011	
				ED	Exposure Duration	0.5	years	MEDEP, 2011	CA = CW x CF x VF
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2012	

Notes:

1 - Professional judgment.

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

VDEQ, 2012: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 8.48E-08

Noncancer Inhalation Intake = 1.19E-05

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - GROUNDWATER TO AIR NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2012	Exposure Concentration (mg/m ³) =
				CW	Chemical concentration in water.	Max or 95% UCL	ug/L		
				CF	Conversion Factor	0.001	mg/ug		<u>CA x ET x EF x ED</u>
				ET	Exposure Time	2	hours/day	(1)	AT x 24 hours/day
				EF	Exposure Frequency	15	days/year	(1)	
				ED	Exposure Duration	0.5	years	MEDEP, 2011	CA = CW x CF x VF
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2012	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

VDEQ, 2012: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 2.45E-08

Noncancer Inhalation Intake = 3.42E-06

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	4	hours/event	(1)	<u>CW x CF x CR x ET x EF x ED</u>
				EF	Exposure Frequency	26	events/year	MEDEP, 2011	BW x AT
				ED	Exposure Duration	0.5	years	MEDEP, 2011	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3,470	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	26	days/year	MEDEP, 2011	For organics if tevent > t*
				ED	Exposure Duration	0.5	years	MEDEP, 2011	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	

Notes:

1 - Professional judgment. Assumes construction workers are only exposed to surface water during part of the construction project. MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.54E-10 Car

Noncancer Ingestion Intake = 3.56E-08 Noncar

Cancer Dermal Intake = 2.21E-02 Noncancer Dermal Intake = 3.09E+00

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

 $\label{eq:hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral \ Reference \ Dose$

 $Hazard\ Index\ from\ dermal\ contact = Surface\ Water\ concentration\ x\ Noncancer\ Dermal\ Intake\ x\ DAevent\ /\ Dermal\ Reference\ Dose$

TABLE 4.5.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SURFACE WATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	15	events/year	(1)(2)	BW x AT
				ED	Exposure Duration	0.5	years	MEDEP, 2011	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3,470	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	15	days/year	(1)(2)	For organics if tevent > t*
				ED	Exposure Duration	0.5	years	MEDEP, 2011	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	182.5	days	USEPA, 2014	

Notos:

- 1 Professional judgment. Assumes construction workers are only exposed to sediment during part of the construction project.
- 2 Some values are 50 percent of RME.

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

 $USEPA, 2014: Human\ Health\ Evaluation\ Manual,\ Supplemental\ Guidance: Update\ of\ Standard\ Default\ Exposure\ Factors.\ OSWER\ 9200.1-120.$

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

 $Hazard\ Index\ from\ ingestion = Surface\ Water\ concentration\ x\ Noncancer\ Ingestion\ Intake\ /\ Oral\ Reference\ Dose$

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

${\sf REASONABLE\ MAXIMUM\ EXPOSURE\ -\ CONSTRUCTION\ WORKERS\ -\ SEDIMENT}$

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	30	days/year	(1)	
				ED	Exposure Duration	1	years	USEPA, 2002b	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	3,470	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	30	days/year	(1)	
				ED	Exposure Duration	1	years	USEPA, 2002b	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	

Notes:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

^{1 -} Professional judgment. Assumes construction workers are only exposed to sediment during part of the construction project. Sources:

TABLE 4.6.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	15	days/year	(2)	
				ED	Exposure Duration	1	years	USEPA, 2002b	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	
Dermal	Construction Workers	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	3,470	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	15	days/year	(2)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Receptor is only at the site part of the day.
- 2 Professional judgment. Assumes construction workers are only exposed to sediment during part of the construction project. Values are 50 percent of RME.

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 1.21E-09

Cancer Dermal Intake = 2.55E-09

Noncancer Ingestion Intake = 8.48E-08

Noncancer Dermal Intake = 1.78E-07

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - OCCUPATIONAL WORKERS - SOIL NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Occupational Workers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2014	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	250	days/year	USEPA, 2014	
				ED	Exposure Duration	25	years	USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 2014	
Dermal	Occupational Workers	Adult	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	3470	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.12	mg/cm2/event	USEPA, 2014	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	USEPA, 2014	
				ED	Exposure Duration	25	years	USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 2014	

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December. USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005. USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.7.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - OCCUPATIONAL WORKERS - SOIL NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Occupational Workers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 2014	
Dermal	Occupational Workers	Adult	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	3470	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.02	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	125	days/year	(1)	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 2014	

^{1 -} Professional judgment. Values are 50 percent of RME.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.75E-08

Cancer Dermal Intake = 3.82E-08

Noncancer Ingestion Intake = 2.14E-07

Noncancer Dermal Intake = 2.97E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

 $Hazard\ Index\ from\ dermal\ contact = Soil\ concentration\ x\ Noncancer\ Dermal\ Intake\ x\ Absorption\ Factor\ /\ Dermal\ Reference\ Dose$

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - OCCUPATIONAL WORKERS - SOIL TO AIR NAS BRUNSWICK, BRUNSWICK, MAINE

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Scenario Timeframe: Current/Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Occupational Workers	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	USEPA, 2014a	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	250	days/year	USEPA, 2014a	AT x 24 hours/day
				ED	Exposure Duration	25	years	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://rais.ornl.gov/epa/ssl1.shtml. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 8.15E-02

Noncancer Inhalation Intake = 2.28E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.8.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - OCCUPATIONAL WORKERS - SOIL TO AIR $% \left(1\right) =\left(1\right) \left(

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Occupational Workers	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	USEPA, 2014a	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	125	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	9	years	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Professional judgment. Values are 50 percent of RME.

Sources:

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://rais.ornl.gov/epa/ssl1.shtml. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.47E-02

Noncancer Inhalation Intake = 1.14E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.9.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	(1)	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	45	days/year	(2)	
				ED	Exposure Duration (Age 6 - 16)	10	years	(3)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	5,300	cm2	(4)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	45	days/year	(2)	
				ED	Exposure Duration (Age 6 - 16)	10	years	(3)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	

Notes:

- 1 Same as adult resident exposures.
- 2 Professional judgment.
- 3 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).
- 4 Assumes head, hands, forearms, lower legs, and feet are exposed (USEPA, 2004).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2004: Risk \ Assessment \ Guidance \ for \ Superfund \ (Part \ E, \ Supplemental \ Guidance \ for \ Dermal \ Risk \ Assessment) \ Final. \ EPA/540/R/99/005.$

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.39E-08

Cancer Dermal Intake = 3.59E-07

Noncancer Ingestion Intake = 2.37E-07

Noncancer Dermal Intake = 2.51E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.9.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future Medium: Surface Soil/Subsurface Soil Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(1)	
				CF3	Conversion Factor 3	0.000001	kg/mg		CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	25	days/year	(2)	
				ED	Exposure Duration (Age 6 - 16)	5	years	(3)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1825	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	5,300	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	25	days/year	(2)	
				ED	Exposure Duration (Age 6 - 16)	5	years	(2)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1825	days	USEPA, 1989	

Notes

- 1 Same as adult resident exposures.
- 2 Professional judgment.
- 3 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).
- 4 Assumes head, hands, forearms, lower legs, and feet are exposed (USEPA, 2004).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.70E-09

Cancer Dermal Intake = 1.99E-08

Noncancer Ingestion Intake = 6.59E-08

Noncancer Dermal Intake = 2.79E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.10.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	45	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration (Age 6 - 16)	10	years	(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.47E-03

Noncancer Inhalation Intake = 1.03E-02

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.10.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS ${\tt CENTRAL\ TENDENCY\ EXPOSURES\ -\ ADOLESCENT\ TRESPASSERS\ -\ SOILS\ TO\ AIR}$

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	25	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	5	years	(2)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	1,825	days	USEPA, 1989	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2012: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 4.08E-04

Noncancer Inhalation Intake = 5.71E-03

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.11.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SURFACE WATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2.6	hours/event	MEDEP, 2011	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	45	events/year	(1)	BW x AT
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2.6	hr/event	MEDEP, 2011	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	45	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	52	kg	USEPA, 1997	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

- 1 Professional judgment.
- 2 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 8.81E-09

Cancer Dermal Intake = 1.80E+00

Noncancer Ingestion Intake = 6.16E-08

Noncancer Dermal Intake = 1.26E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.11.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SURFACE WATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	25	events/year	(1)	BW x AT
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	25	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	10	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	52	kg	USEPA, 1997	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

- 1 Professional judgment.
- 2 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.76E-09

Noncancer Ingestion Intake = 2.63E-08

Cancer Dermal Intake = 9.97E-01

Noncancer Dermal Intake = 6.98E+00

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.12.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	45	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	5,300	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	45	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	

Notes:

- 1 Professional judgment.
- 2 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).
- 3 Assumes head, hands, forearms, lower legs, and feet are exposed (USEPA, 2004).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2004: Risk \ Assessment \ Guidance \ for \ Superfund \ (Part \ E, \ Supplemental \ Guidance \ for \ Dermal \ Risk \ Assessment) \ Final. \ EPA/540/R/99/005.$

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.39E-08

Cancer Dermal Intake = 3.59E-07

Noncancer Ingestion Intake = 2.37E-07

Noncancer Dermal Intake = 2.51E-06

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.12.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SEDIMENT NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	25	days/year	(1)	
				ED	Exposure Duration	5	years	(2)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1,825	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	5,300	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	25	days/year	(1)	
				ED	Exposure Duration	5	years	(2)	
				BW	Body Weight	52	kg	USEPA, 1997	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	1,825	days	USEPA, 1989	

- 1 Professional judgment.
- 2 Adolescents will be evaluated as one age group (6 16 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, the intake for adolescent trespassers will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).
- 3 Assumes head, hands, forearms, lower legs, and feet are exposed (USEPA, 2004).

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.70E-09

Cancer Dermal Intake = 1.99E-08

Noncancer Ingestion Intake = 6.59E-08

Noncancer Dermal Intake = 2.79E-07

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.13.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT TRESPASSERS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	(1)	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	45	days/year	(2)	
				ED	Exposure Duration (Age 16 - 26)	10	years	(3), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 2014	
Dermal	Trespassers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	45	days/year	(1)	
				ED	Exposure Duration (Age 16 - 26)	10	years	(3), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 2014	

Notes:

- 1 Same as adult resident exposures.
- 2 Professional judgment.
- 3 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.20E-08

Cancer Dermal Intake = 9.30E-08

Noncancer Ingestion Intake = 1.54E-07

Noncancer Dermal Intake = 6.51E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.13.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - ADULT TRESPASSERS - SOILS NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(1)	
				CF3	Conversion Factor 3	0.000001	kg/mg		CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	25	days/year	(2)	
				ED	Exposure Duration	7	years	(3), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 2014	
Dermal	Trespassers	Adult	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	25	days/year	(2)	
				ED	Exposure Duration	7	years	(3), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 2014	

Notes

- 1 Same as adult resident exposures.
- 2 Professional judgment.
- 3 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.28E-09

Noncancer Ingestion Intake = 4.28E-08

Cancer Dermal Intake = 5.16E-09 Noncancer Dermal Intake = 5.16E-08

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.14.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT TRESPASSERS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	45	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration (Age 16 - 26)	10	years	(3), USEPA, 2014a	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

- 1 Professional judgment.
- 2 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.47E-03

Noncancer Inhalation Intake = 1.03E-02

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.14.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SOILS TO AIR NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	25	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	7	years	(2), USEPA, 2014a	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

- 1 Professional judgment.
- 2 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2012: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 5.71E-04

Noncancer Inhalation Intake = 5.71E-03

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.15.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT TRESPASSERS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2.6	hours/event	MEDEP, 2011	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	45	events/year	(1)	BW x AT
				ED	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014	
Dermal	Trespassers	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2.6	hr/event	MEDEP, 2011	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	45	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.72E-09

Cancer Dermal Intake = 1.33E+00

Noncancer Ingestion Intake = 4.01E-08

Noncancer Dermal Intake = 9.30E+00

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.15.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT TRESPASSERS - SURFACE WATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	25	events/year	(1)	BW x AT
				ED	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014	
Dermal	Trespassers	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	25	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.45E-09

Cancer Dermal Intake = 7.38E-01

Noncancer Ingestion Intake = 1.71E-08

Noncancer Dermal Intake = 5.16E+00

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.16.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	45	days/year	(1)	
				ED	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014	
Dermal	Trespassers	Adolescent	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	45	days/year	(1)	
				ED	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.20E-08

Noncancer Ingestion Intake = 1.54E-07

Cancer Dermal Intake = 9.30E-08 Noncancer Dermal Intake = 6.51E-07

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.16.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SEDIMENT NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	25	days/year	(1)	
				ED	Exposure Duration (Age 16 - 26)	7	years	(2), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Trespassers	Adolescent	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	25	days/year	(1)	
				ED	Exposure Duration (Age 16 - 26)	7	years	(2), USEPA, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 4.28E-09

Cancer Dermal Intake = 5.16E-09

Noncancer Ingestion Intake = 4.28E-08

Noncancer Dermal Intake = 5.16E-08

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.17.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SOILS NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1997	
				CF3	Conversion Factor 3	0.000001	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 2014	
Dermal	Recreational User	Child	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 2014	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 9.39E-08 Cancer Dermal Intake (Age 0 - 2) = 2.53E-07 Cancer Ingestion Intake (Age 2 - 6) = 1.88E-07 Cancer Dermal Intake (Age 2 - 6) = 5.05E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 3.29E-06 Noncancer Dermal Intake = 8.84E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.17.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SOILS NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg		CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
Dermal	Recreational User	Child	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 4.70E-08 Cancer Dermal Intake = 5.05E-08

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 2.35E-08 Cancer Dermal Intake (Age 0 - 2) = 2.53E-08 Cancer Ingestion Intake (Age 2 - 6) = 2.53E-08 Cancer Dermal Intake (Age 2 - 6) = 2.53E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.64E-06 Noncancer Dermal Intake = 1.77E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.18.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Child	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F_D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

 ${\sf USEPA, 2002a: Supplemental \ Guidance \ for \ Developing \ Soil \ Screening \ Levels \ for \ Superfund \ Sites. \ OSWER \ 9355.4-24.}$

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = $(ET \times EF \times ED)/(AT \times 24 \text{ hours/day})$

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 6) = 1.76E-03 Noncancer Inhalation Intake = 2.05E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 5.87E-04Cancer Inhalation Intake (Age 2 - 6) = 1.17E-03

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.18.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Child	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014a	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F_D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 5.87E-04 Noncancer Inhalation Intake = 2.05E-02 Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 2.94E-04 Cancer Inhalation Intake (Age 2 - 6) = 2.94E-04

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.19.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.05	L/hr	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2.6	hours/event	MEDEP, 2011	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	78	events/year	MEDEP, 2011	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Recreational User	Child	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2.6	hr/event	MEDEP, 2011	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

- Professional judgment.
- 2 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = $(CR \times CF \times ET \times EF \times ED)/(BW \times AT)$ Dermal Intake = $(SA \times EV \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 1.59E-07 Cancer Dermal Intake (Age 0 - 6) = 3.28E+00

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 5.29E-08 Cancer Dermal Intake (Age 0 - 2) = 1.09E+00 Cancer Ingestion Intake (Age 2 - 6) = 1.06E-07 Cancer Dermal Intake (Age 2 - 6) = 2.19E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.85E-06 Noncancer Dermal Intake = 3.83E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.19.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.05	L/hr	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	30	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
Dermal	Recreational User	Child	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 2005, 2014	2 x τ +(1 + 3B + 3B²)/(1+B²)
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December. USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = $(CR \times CF \times ET \times EF \times ED)/(BW \times AT)$ Dermal Intake = $(SA \times EV \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 1.57E-08 Cancer Dermal Intake = 4.38E-01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 7.83E-09 Cancer Dermal Intake (Age 0 - 2) = 2.19E-01 Cancer Ingestion Intake (Age 2 - 6) = 7.83E-09 Cancer Dermal Intake (Age 2 - 6) = 2.19E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 5.48E-07 Noncancer Dermal Intake = 1.53E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.20.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RECREATIONAL USERS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Recreational User	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

 $USEPA, 1991: Human\ Health\ Evaluation\ Manual,\ Supplemental\ Guidance:\ Standard\ Default\ Exposure\ Factors.\ OSWER\ Directive\ 9285.6-03.$

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

 $USEPA, 2014: Human\ Health\ Evaluation\ Manual,\ Supplement\ Guidance,\ Update\ of\ Standard\ Default\ Exposure\ Factors.\ OSWER\ 9200.1-120.$

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 8.14E-08 Cancer Dermal Intake (Age 0 - 2) = 2.19E-07 Cancer Ingestion Intake (Age 2 - 6) = 1.63E-07 Cancer Dermal Intake (Age 2 - 6) = 4.38E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.85E-06 Noncancer Dermal Intake = 7.66E-06

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.20.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RECREATIONAL USERS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	(1)	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	30	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
Dermal	Recreational User	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	30	days/year	(1)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 7.83E-09 Cancer Dermal Intake (Age 0 - 2) = 8.42E-09 Cancer Ingestion Intake (Age 2 - 6) = 7.83E-09 Cancer Dermal Intake (Age 2 - 6) = 8.42E-09

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 5.48E-07 Noncancer Dermal Intake = 5.90E-07

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

 $\label{eq:hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral \ Reference \ Dose$

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.21.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	(1)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1)(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1)(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Recreational User	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1)(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1)(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

- 1 Same as adult resident exposures.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 4.40E-08

Cancer Ingestion Intake (Age 6 - 16) = 4.40E-08

Cancer Ingestion Intake (Age 16 - 26) = 4.40E-08

Cancer Dermal Intake (Age 16 - 26) = 1.86E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 3.08E-07 Noncancer Dermal Intake = 1.30E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.21.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	(1)	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1)(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1)(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Recreational User	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1)(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1)(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

Notes:

- 1 Same as adult resident exposures.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Cancer Dermal Intake = 1.86E-08

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 1.54E-08

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 4.40E-09 Cancer Dermal Intake (Age 6 - 16) = 5.31E-09 Cancer Ingestion Intake Age 16 - 26) = 1.10E-08 Cancer Dermal Intake (Age 16 - 26) = 1.33E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.54E-07 Noncancer Dermal Intake = 1.86E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.22.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future
Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	
				AT-N	Averaging Time (Non-Cancer)	7300	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Noncarcinogenic Chemicals

Cancer Inhalation Intake (Age 6 - 30) = 5.87E-03

Noncancer Inhalation Intake = 2.05E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 2.94E-03 Cancer Inhalation Intake (Age 16 - 26) = 2.94E-03

 ${\tt Cancer\ risk\ from\ inhalation\ =\ Air\ concentration\ x\ Cancer\ Inhalation\ Intake\ x\ Inhalation\ Cancer\ Slope\ Factor\ and a supplementation\ and a su$

 $\label{eq:hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose$

TABLE 4.22.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SOILS TO AIR $\ensuremath{\mathsf{N}}$

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	MEDEP, 2009	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	90	days/year	MEDEP, 2009	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014a	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F_D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2009: Guidance for Human Health Risk Assessment for Hazardous Substance Sites in Maine. DEP-BRWM 2B 2009, July.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Noncarcinogenic Chemicals

Cancer Inhalation Intake = 2.05E-03

Noncancer Inhalation Intake = 2.05E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 5.87E-04

Cancer Inhalation Intake (Age 16 - 26) = 1.47E-03

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.23.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2.6	hours/event	MEDEP, 2011	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	78	events/year	MEDEP, 2011	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Recreational User	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2.6	hr/event	MEDEP, 2011	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

- Professional judgment.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = $(CR \times CF \times ET \times EF \times ED)/(BW \times AT)$ Dermal Intake = $(SA \times EV \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 1.98E-08 Cancer Dermal Intake (Age 6 - 30) = 4.60E+00

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 9.92E-09 Cancer Dermal Intake (Age 6 - 16) = 2.30E+00 Cancer Ingestion Intake (Age 16 - 26) = 9.92E-09 Cancer Dermal Intake (Age 16 - 26) = 2.30E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 6.95E-08 Noncancer Dermal Intake = 1.61E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.23.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	30	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 30)	10	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Recreational User	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	10	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Assume two days a week in warm weather months for RME and one day a week for CTE.
- 2 Adults will be evaluated as one age group (7 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 7 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December. USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005. USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 5.87E-09 Cancer Dermal Intake = 8.85E-01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 2.94E-09 Cancer Dermal Intake (Age 6 - 16) = 8.85E-01 Cancer Ingestion Intake (Age 16 - 30) = 2.94E-09 Cancer Dermal Intake (Age 16 - 30) = 8.85E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.05E-08 Noncancer Dermal Intake = 6.20E+00

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.24.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RECREATIONAL USERS - SEDIMENT NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Recreational User	Adult	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

 $\label{eq:medel} \textbf{MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.}$

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2004: Risk \ Assessment \ Guidance \ for \ Superfund \ (Part \ E, \ Supplemental \ Guidance \ for \ Dermal \ Risk \ Assessment) \ Final. \ EPA/540/R/99/005.$

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 7.63E-08 Cancer Dermal Intake (Age 6 - 30) = 3.22E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 3.82E-08 Cancer Dermal Intake (Age 6 - 16) = 1.61E-07

Cancer Ingestion Intake (Age 16 - 26) = 3.82E-08 Cancer Dermal Intake (Age 16 - 26) = 1.61E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.67E-07 Noncancer Dermal Intake = 1.13E-06

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.24.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RECREATIONAL USERS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment

Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	(1)	BW x AT
				EF	Exposure Frequency	30	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Recreational User	Adult	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	30	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adult recreational users will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.47E-09 Cancer Dermal Intake (Age 6 - 16) = 1.77E-09 Cancer Ingestion Intake (Age 16 - 26) = 3.67E-09 Cancer Dermal Intake (Age 16 - 26) = 4.43E-09

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 5.14E-08 Noncancer Dermal Intake = 6.20E-08

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.25.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future

Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Resident	Child	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 1.10E-06 Cancer Dermal Intake (Age 0 - 6) = 2.95E-06

Mutagenic Chemicals

Cancer Ingestion Intake $(Age\ 0 - 2) = 3.65E-07$ Cancer Dermal Intake $(Age\ 0 - 2) = 9.83E-07$ Cancer Ingestion Intake $(Age\ 2 - 6) = 7.31E-07$ Cancer Dermal Intake $(Age\ 2 - 6) = 1.97E-06$

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 3.44E-05

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

 $Hazard\ Index\ from\ dermal\ contact = Soil\ concentration\ x\ Noncancer\ Dermal\ Intake\ x\ Absorption\ Factor\ /\ Dermal\ Reference\ Dose$

TABLE 4.25.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future

Medium: Surface Soil/Subsurface Soil

Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
Dermal	Resident	Child	Site 12	cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake $(Age\ 0\ -\ 2)=6.11E-08$ Cancer Dermal Intake $(Age\ 0\ -\ 2)=6.57E-08$ Cancer Ingestion Intake $(Age\ 2\ -\ 6)=6.11E-08$ Cancer Dermal Intake $(Age\ 2\ -\ 6)=6.57E-08$

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.27E-06 Noncancer Dermal Intake = 4.60E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.26.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS SOILS TO AIR NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 2002a	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	350	days/year	USEPA, 2014	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014a	$CA = (1/PEF + 1/VF) \times Cs$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Noncarcinogenic Chemicals

Cancer Inhalation Intake (Age 0 - 6) = 8.22E-02

Noncancer Inhalation Intake = 9.59E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 2.74E-02

Cancer Inhalation Intake (Age 2 - 6) = 5.48E-02

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.26.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 2002a	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	234	days/year	USEPA, 2002a	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014a	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F_D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2014: Human\ Health\ Evaluation\ Manual,\ Supplement\ Guidance,\ Update\ of\ Standard\ Default\ Exposure\ Factors.\ OSWER\ 9200.1-120.$

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = $(ET \times EF \times ED)/(AT \times 24 \text{ hours/day})$

Non-Mutagenic Chemicals

Noncarcinogenic Chemicals

Cancer Inhalation Intake = 1.83E-02

Noncancer Inhalation Intake = 6.41E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 9.16E-03 Cancer Inhalation Intake (Age 2 - 6) = 9.16E-03

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.27.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - GROUNDWATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Groundwater Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	Site 12	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 2002a	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug		
				IR-GW	Ingestion Rate of Groundwater	0.78	L/day	USEPA, 2014	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 2014	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2002b	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Residents	Child	Site 12	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/L	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.54	hr/event	USEPA, 2014	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,378	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	15	kg	USEPA, 2002b	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake $(Age\ 0 - 2) = 1.42E-06$ Cancer Dermal Intake $(Age\ 0 - 2) = 1.16E+01$ Cancer Ingestion Intake $(Age\ 2 - 6) = 2.85E-06$ Cancer Dermal Intake $(Age\ 2 - 6) = 2.33E+01$

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.99E-05 Noncancer Dermal Intake = 4.08E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.27.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Groundwater Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	Site 12	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug		
				IR-GW	Ingestion Rate of Groundwater	0.74	L/day	USEPA, 1997	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 2004	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
Dermal	Residents	Child	Site 12	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/L	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.33	hr/event	USEPA, 1997	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,378	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 1993	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 6.76E-07 Cancer Dermal Intake (Age 0 - 2) = 5.82E+00 Cancer Ingestion Intake (Age 2 - 6) = 6.76E-07 Cancer Dermal Intake (Age 2 - 6) = 5.82E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.73E-05 Noncancer Dermal Intake = 4.08E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.28.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Child	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 1991	Exposure Concentration (mg/m³) =
				GW	Chemical concentration in water.	95% UCL or Max	ug/L	USEPA, 2002	
				CF	Conversion Factor	0.001	mg/ug		CA x ET x EF x ED
				ET	Exposure Time	24	hours/day	USEPA, 1991	AT x 24 hours/day
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 2005, 2014	CA = CW x CF x VF
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 2005, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 2014	
				VF	Volatilization Factor	0.5	L/m3	USEPA, 1991	

Notes:

USEPA, 1991: Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation Goals. OSWER Directive 9285.7-01B.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 8.22E-05

Noncancer Inhalation Intake = 9.59E-04

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

^{1 -} Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

TABLE 4.28.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE - CHILD RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

<u>Exposure</u> Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Child	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 1991	Exposure Concentration (mg/m ³) =
				GW	Chemical concentration in water.	95% UCL or Max	ug/L	USEPA, 2002	
				CF	Conversion Factor	0.001	mg/ug		CA x ET x EF x ED
				ET	Exposure Time	24	hours/day	USEPA, 1991	AT x 24 hours/day
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 2005, 2014	CA = CW x CF x VF
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 2005, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
				VF	Volatilization Factor	0.5	L/m3	USEPA, 1991	

Notes:

USEPA, 1991: Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation Goals. OSWER Directive 9285.7-01B.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 2.74E-05

Noncancer Inhalation Intake = 9.59E-04

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

^{1 -} Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

TABLE 4.29.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2.6	hours/event	MEDEP, 2011	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	78	events/year	MEDEP, 2011	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Resident	Child	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2.6	hr/event	MEDEP, 2011	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	DAevent= $2 \times FA \times Kp \times Cw \times CF \times sqrt[(6 \times \tau \times tevent)/pi]$
				EV	Event Frequency	1	events/day	(1)(2)	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Receptor is only at the site part of the day.
- 2 Assumes one hour a day for one day a week for 24 weeks during late spring, summer, and early fall.
- 3 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = $(CR \times CF \times ET \times EF \times ED)/(BW \times AT)$ Dermal Intake = $(SA \times EV \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 3.17E-08 Cancer Dermal Intake (Age 0 - 6) = 3.28E+00

Mutagenic Chemicals

Cancer Dermal Intake (Age 0 - 2) = 1.09E+00 Cancer Ingestion Intake (Age 0 - 2) = 1.06E-08 Cancer Ingestion Intake (Age 2 - 6) = 2.12E-08 Cancer Dermal Intake (Age 2 - 6) = 2.19E+00

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 3.70E-07 Noncancer Dermal Intake = 3.83E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.29.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hr	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)(2)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	30	events/year	(1)(2)	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Resident	Child	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)(2)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)(2)	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(3), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

- 1 Professional judgment.
- 2 Same as child recreational user exposure.
- 3 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.13E-09 Cancer Dermal Intake (Age 0 - 2) = 4.21E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.10E-07 Noncancer Dermal Intake = 1.47E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.30.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2002b	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	
Dermal	Resident	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 2002b	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Receptor is only at the site part of the day.
- 2 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2002b: Supplemental\ Guidance\ for\ Developing\ Soil\ Screening\ Levels\ for\ Superfund\ Sites.\ OSWER\ 9355.4-24.$

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 4.07E-08 Cancer Dermal Intake (Age 0 - 2) = 2.19E-07 Cancer Ingestion Intake (Age 2 - 6) = 8.14E-08 Cancer Dermal Intake (Age 2 - 6) = 4.38E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.42E-06 Noncancer Dermal Intake = 7.66E-06

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.30.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	30	days/year	(1)(2)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	
Dermal	Resident	Child	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	2,690	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	30	days/year	(1)(2)	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(3), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	15	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Receptor is only at the site part of the day.
- 2 Same as child recreational user exposure.
- 3 Children will be evaluated as one age group (0 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, children recreational users will be evaluated as two age groups, 0 2 years and 2 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2004: Risk \ Assessment \ Guidance \ for \ Superfund \ (Part \ E, \ Supplemental \ Guidance \ for \ Dermal \ Risk \ Assessment) \ Final. \ EPA/540/R/99/005.$

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.91E-09 Cancer Dermal Intake (Age 0 - 2) = 8.42E-09 Cancer Ingestion Intake (Age 2 - 6) = 3.91E-09 Cancer Dermal Intake (Age 2 - 6) = 8.42E-09

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.74E-07 Noncancer Dermal Intake = 5.90E-07

 $Cancer\ risk\ from\ ingestion = Sediment\ concentration\ x\ Cancer\ Ingestion\ Intake\ x\ Oral\ Cancer\ Slope\ Factor$

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.31.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future

Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Resident	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = $(CF3 \times SA \times SSAF \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.71E-07 Cancer Dermal Intake (Age 6 - 16) = 7.23E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.20E-06 Noncancer Dermal Intake = 5.06E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.31.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SOILS

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future

Medium: Surface Soil/Subsurface Soil
Exposure Medium: Surface/Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless		BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Resident	Adult	Site 12	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.14E-08 Cancer Dermal Intake (Age 6 - 16) = 1.38E-08 Cancer Ingestion Intake (Age 16 - 26) = 2.86E-08 Cancer Dermal Intake (Age 16 - 26) = 3.45E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.01E-07 Noncancer Dermal Intake = 4.83E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

 $\label{eq:local_problem} \mbox{Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose x (a) x (b) x (c)

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.32.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future

Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				cs	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 2002a	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	350	days/year	USEPA, 2014	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014a	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014a	$CA = (1/PEF + 1/VF) \times Cs$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	
				AT-N	Averaging Time (Non-Cancer)	7300	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F _D	dispersion correction factor	1	unitless	USEPA, 2014b	
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

 $USEPA, 2014a: Human\ Health\ Evaluation\ Manual,\ Supplement\ Guidance,\ Update\ of\ Standard\ Default\ Exposure\ Factors.\ OSWER\ 9200.1-120.$

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Noncarcinogenic Chemicals

Cancer Inhalation Intake (Age 6 - 30) = 2.74E-01

Noncancer Inhalation Intake = 9.59E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.37E-01

Cancer Inhalation Intake (Age 16 - 26) = 1.37E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.32.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SOILS TO AIR

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Surface/Subsurface Soil

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m³) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 2002a	<u>CA x ET x EF x ED</u>
				EF	Exposure Frequency	234	days/year	USEPA, 2002b	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014a	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 2014a	
				PEF	Particulate Emission Factor	9.37E+09	m3/kg	USEPA, 2014b	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at	74.3185	g/m2-s per	USEPA, 2014b	
					center of source		kg/m3		
				F_D	dispersion correction factor	1	unitless	USEPA, 2014b	$F(x) = 0.18 * (8x^3 + 12x) * exp(-x^2)$
				Ut	Equivalent threshold of wind velocity at 7m.	11.32	m/sec	USEPA, 2014b	
				Um	Mean annual wind speed	3.89	m/sec	USEPA, 2014b	
				V	Fraction of vegetative cover	0.5	unitless	USEPA, 2014b	
				F(x)	Function dependent of Um/Ut	0.0391	unitless	USEPA, 2014b	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2014a: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA, 2014b: Soil Screening Guidance calculation Internet site at http://risk.lsd.ornl.gov/calc_start.htm. Site-specific values for Portland, Maine.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Noncarcinogenic Chemicals

Cancer Inhalation Intake = 6.41E-02

Noncancer Inhalation Intake = 6.41E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.83E-02

Cancer Inhalation Intake (Age 16 - 26) = 4.58E-02

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.33.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

${\sf REASONABLE\ MAXIMUM\ EXPOSURE\ -\ ADULT\ RESIDENTS\ -\ GROUNDWATER}$

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Groundwater Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 12	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug		
				IR-GW	Ingestion Rate of Groundwater	2.5	L/day	USEPA, 2014	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 2014	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Residents	Adult	Site 12	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/L	USEPA, 2002	DAevent x EV x EF x ED x SA
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	BW x AT
				CF	Conversion factor	0.001	L/cm ³		
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	For inorganics
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	0.71	hr/event	USEPA, 2014	For organics if tevent <= t*
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	DAevent= $2 \times FA \times Kp \times Cw \times CF \times sqrt[(6 \times \tau \times tevent)/pi]$
				SA	Skin Surface Available for Contact	20,900	cm2	USEPA, 2014	
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2014	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 4.28E-06

Cancer Dermal Intake (Age 6 - 16) = 3.58E+01 Cancer Dermal Intake (Age 16 - 26) = 3.58E+01

Noncancer Ingestion Intake = 3.00E-05 Noncancer Dermal Intake = 2.51E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.33.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Future Medium: Groundwater Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 12	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug		
				IR-GW	Ingestion Rate of Groundwater	1.4	L/day	USEPA, 1993	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 2004	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Residents	Adult	Site 12	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.25	hr/event	USEPA, 1997	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	20,900	cm2	USEPA, 2014	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

Notes

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 4.79E-07 Cancer Dermal Intake (Age 6 - 16) = 7.16E+00 Cancer Ingestion Intake (Age 16 - 26) = 1.20E-06 Cancer Dermal Intake (Age 16 - 26) = 1.79E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.68E-05 Noncancer Dermal Intake = 2.51E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.34.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

<u>Exposure</u> Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 1991	Exposure Concentration (mg/m ³) =
				GW	Chemical concentration in water.	95% UCL or Max	ug/L	USEPA, 2002	
				CF	Conversion Factor	0.001	mg/ug		CA x ET x EF x ED
				ET	Exposure Time	24	hours/day	USEPA, 1991	AT x 24 hours/day
				EF	Exposure Frequency	350	days/year	USEPA, 2014	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 2005, 2014	CA = CW x CF x VF
				ED2	Exposure Duration (Age 16 - 26)	10	years	(1), USEPA, 2005, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7300	days	USEPA, 2014	
				VF	Volatilization Factor	0.5	L/m3	USEPA, 1991	

Notes:

1 - Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1991: Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation Goals. OSWER Directive 9285.7-01B.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 2.74E-04

Noncancer Inhalation Intake = 9.59E-04

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.34.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Groundwater

Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Adult	Site 12	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 1991	Exposure Concentration (mg/m ³) =
				GW	Chemical concentration in water.	95% UCL or Max	ug/L	USEPA, 2002	
				CF	Conversion Factor	0.001	mg/ug		CA x ET x EF x ED
				ET	Exposure Time	24	hours/day	USEPA, 1991	AT x 24 hours/day
				EF	Exposure Frequency	350	days/year	USEPA, 2004	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 2005, 2014	CA = CW x CF x VF
				ED2	Exposure Duration (Age 16 - 26)	5	years	(1), USEPA, 2005, 2014	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 2014	
				VF	Volatilization Factor	0.5	L/m3	USEPA, 1991	

Notes:

USEPA, 1991: Human Health Evaluation Manual, Part B: Development of Risk-based Preliminary Remediation Goals. OSWER Directive 9285.7-01B.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 9.59E-05

Noncancer Inhalation Intake = 9.59E-04

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

^{1 -} Adults will be evaluated as one age group (6 - 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 - 16 years and 16 - 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

TABLE 4.35.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2.6	hours/event	MEDEP, 2011	<u>CW x CF x CR x ET x EF x ED</u>
				EF	Exposure Frequency	78	events/year	MEDEP, 2011	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Residents	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2.6	hr/event	MEDEP, 2011	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(2), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 26)	10	years	(2), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

- 1 Professional judgment. Receptor is only at the site part of the day.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = $(CR \times CF \times ET \times EF \times ED)/(BW \times AT)$ Dermal Intake = $(SA \times EV \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 1.98E-08 Cancer Dermal Intake (Age 6 - 30) = 4.60E+00

Mutagenic Chemicals

Cancer Dermal Intake (Age 6 - 16) = 2.30E+00

Cancer Ingestion Intake (Age 6 - 16) = 9.92E-09 Cancer Dermal Intake (Age 16 - 26) = 2.30E+00 Cancer Ingestion Intake (Age 16 - 26) = 9.92E-09

Noncancer Ingestion Intake = 6.95E-08 Noncancer Dermal Intake = 1.61E+01

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.35.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SURFACE WATER

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Surface Water

Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 12	CW	Chemical Concentration in Water	Max or 95% UCL	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CR	Contact Rate	0.01	L/hour	USEPA 4, 2014	
				CF	Conversion factor	0.001	mg/ug		
				ET	Exposure Time	2	hours/event	(1)	CW x CF x CR x ET x EF x ED
				EF	Exposure Frequency	30	events/year	(1)	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Residents	Adult	Site 12	DAevent	Absorbed dose per event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Water	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm ³		BW x AT
				Кр	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	2	hr/event	(1)	
				В	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 2005, 2014	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 26)	5	years	(2), USEPA, 2005, 2014	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Same as adult recreational user exposure.
- 2 Adults will be evaluated as one age group (7 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, adults will be evaluated as two age groups, 7 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120.

USEPA 4, 2014: Region 4 Human Health Risk Assessment Supplemental Guidance.

Unit Intake Calculations

Ingestion Intake = (CR x CF x ET x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 5.87E-10 Cancer Dermal Intake (Age 6 - 16) = 1.67E-01 Cancer Ingestion Intake (Age 16 - 26) = 1.47E-09 Cancer Dermal Intake (Age 16 - 26) = 4.18E-01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.05E-08 Noncancer Dermal Intake = 5.86E+00

Cancer risk from ingestion = Surface Water concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Surface Water concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Surface Water concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Surface Water concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.36.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CSx IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	
Dermal	Residents	Adult	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	78	days/year	MEDEP, 2011	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(3), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	10	years	(3), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	7,300	days	USEPA, 2014	

Notes:

- 1 Professional judgment. Receptor is only at the site part of the day.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

MEDEP, 2011: Guidance for Human Health Risk Assessments for Hazardous Sites in Maine, February.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

 $USEPA, 2002b: Supplemental\ Guidance\ for\ Developing\ Soil\ Screening\ Levels\ for\ Superfund\ Sites.\ OSWER\ 9355.4-24.$

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 3.82E-08 Cancer Dermal Intake (Age 6 - 30) = 3.22E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.91E-08 Cancer Dermal Intake (Age 6 - 16) = 1.61E-07

Cancer Ingestion Intake (Age 16 - 26) = 1.91E-08 Cancer Dermal Intake (Age 16 - 26) = 1.61E-07

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.34E-07 Noncancer Dermal Intake = 1.13E-06

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.36.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SEDIMENT

NAS BRUNSWICK, BRUNSWICK, MAINE

Scenario Timeframe: Current/Future

Medium: Sediment Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	Site 12	CS	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg		CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	0.5	unitless	(1)	BW x AT
				EF	Exposure Frequency	30	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	
Dermal	Residents	Adult	Site 12	cs	Chemical concentration in sediment	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg		
				SA	Skin Surface Available for Contact	6,032	cm2	USEPA, 2014	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	30	days/year	(1)	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(2), USEPA, 2005, 2014	
				ED2	Exposure Duration (Age 16 - 26)	5	years	(2), USEPA, 2005, 2014	
				BW	Body Weight	80	kg	USEPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 2014	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 2014	

- 1 Professional judgment. Same as adult recreational user exposure.
- 2 Adults will be evaluated as one age group (6 26 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 6 16 years and 16 26 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

USEPA, 2014: Human Health Evaluation Manual, Supplement Guidance, Update of Standard Default Exposure Factors. OSWER 9200.1-120.

Unit Intake Calculations

Incidental Ingestion Intake = $(IR-S \times CF3 \times FI \times EF \times ED)/(BW \times AT)$ Dermal Intake = $(CF3 \times SA \times SSAF \times EF \times ED)/(BW \times AT)$

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 2.57E-09 Cancer Dermal Intake = 6.20E-09

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 7.34E-10 Cancer Dermal Intake (Age 6 - 16) = 1.77E-09 Cancer Ingestion Intake (Age 16 - 26) = 1.83E-09 Cancer Dermal Intake (Age 16 - 26) = 4.43E-09

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.57E-08 Noncancer Dermal Intake = 6.20E-08

Cancer risk from ingestion = Sediment concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor Cancer risk from dermal contact = Sediment concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Sediment concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Sediment concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

APPENDIX E

ECOLOGICAL RISK ASSESSMENT METHODOLOGY

ECOLOGICAL RISK ASSESSMENT METHODOLOGY

The goal of the ecological risk assessment (ERA) for the Quarry Area will be to evaluate the potential for adverse ecological impacts of site-related contamination and to determine the need for further investigation and/or remedial action at the site. The ERA will contain information to enable scientists and managers to conclude either that ecological risks at the site are most likely negligible or that further information is necessary to evaluate potential ecological risks at the site.

The ERA will be conducted in accordance with the following guidance documents:

- Navy Policy for Conducting Ecological Risk Assessment, Navy, 1999.
- Navy Guidance for Conducting Ecological Risk Assessments (http://web.ead.anl.gov/ecorisk/index.cfm)
- Final Guidelines for Ecological Risk Assessment, United States Environmental Protection Agency (USEPA), 1998.
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, USEPA, 1997.

The ERA will consist of Steps 1, 2, and 3a of the eight step ERA process. The first two screening steps comprise the screening-level ecological risk assessment (SERA), and correspond with Tier 1 of the Navy Policy (Navy, 1999), where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a is the first step of a baseline ecological risk assessment (BERA) and consists of refining the Tier 1 assumptions following Steps 1 and 2 to further focus the ERA process on the chemicals of greatest concern at a site. Step 3a corresponds with the first part of Tier 2 of the Navy Policy (Navy, 1999). The remaining steps of the ERA process require revision to the Work Plan and Field Sampling Plan prior to initiation, and will not be included in the ERA.

1.0 Tier 1, Step 1: Screening-Level Problem Formulation and Ecological Effects Evaluation

Problem formulation is the first step of an ERA. The problem formulation process enables the risk assessor to identify the ecological resources to be protected (known as assessment endpoints); the measurements that will be used to evaluate risks to those resources (known as measurement endpoints); and the chemicals, geographic areas, and environmental media relevant to the risk assessment.

1.1 <u>Environmental Setting</u>

The site is a combination of an open field and wooded areas previously used for quarrying activities (1940s-1950s), land-farming of fuel-contaminated soil (1992, 1995), disposal of construction debris, and undocumented training, detonation, and disposal of ordnance/explosives. The Quarry Area encompasses an area of approximately 12 acres and is located southwest of the runways at the former NAS Brunswick western boundary, adjacent to Maine State Route 123 (Harpswell Road). Old Route 24 bisects the site and a radar tower access road borders the site on the north. Surface water runoff at the site flows to the south and west toward surface depressions. Some runoff from the eastern portion of the site flows east. Seasonal standing water bodies approximately 6 inches in depth are present that fill during rain events. Borrow pit appears to be below the water table and so groundwater may have been impacted by direct contact with contaminant sources or via leaching of contaminants from soil to groundwater. Groundwater at the site varies in depth due to the site topography and likely discharges to surface water seasonally, when groundwater levels are elevated. Potential ecological receptors at the site likely include plants, soil invertebrates, sediment invertebrates, aquatic organisms, and small mammals and birds.

1.2 <u>Potential Sources of Contamination</u>

The site is a former rock quarry, land-farming area for fuel-contaminated soil, construction debris disposal site, and training, detonation, and disposal area for ordnance and explosives. Contaminants such as volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), explosives, petroleum hydrocarbons, and metals may have impacted soil and sediment. Infiltration of chemicals through the soil is a potential source of contamination to groundwater, which may then discharge to surface water.

1.3 <u>Potential Exposure Pathways</u>

Terrestrial ecological receptors, such as plants, soil invertebrates, mammals, and birds, can be exposed to contaminated surface soil through direct contact as they search for food and burrow into the soil. Sediment invertebrates and other aquatic organisms can be exposed to chemicals in sediment and surface water. Contaminated groundwater may discharge to small standing water bodies at the site. Aquatic organisms can be exposed to chemicals in surface water after mixing with the groundwater. In addition, sediment invertebrates can be exposed to chemicals in the pore-water after mixing with groundwater. Mammals and birds can also ingest contaminated surface soil and food items in which contaminants have accumulated.

1.4 <u>Assessment and Measurement Endpoints</u>

Assessment endpoints are explicit expressions of the environmental value that is to be protected (USEPA, 1997). The selection of these endpoints is based on the habitats present, the migration pathways of chemicals, and the routes that chemicals may take to enter receptors. Measurement endpoints are estimates of biological impacts (e.g., mortality, growth, reproduction) used to evaluate the assessment endpoints. The assessment and measurement endpoints that will be used to evaluate site data are presented in Table 1. The potential receptors at the site for soil exposure include terrestrial plants, soil invertebrates, sediment invertebrates, aquatic organisms, and herbivorous and insectivorous mammals and birds.

For vertebrate receptors, selection of a particular species is required so that intake through eating can be estimated. The following surrogate species will be used for the food chain modeling:

• Herbivorous mammal: meadow vole

Herbivorous bird: bobwhite quail

Insectivorous mammal: short-tailed shrew

• Insectivorous bird: American robin

USEPA guidance (USEPA, 1997) states that "it is not practical or possible to directly evaluate risks to all of the individual components of the ecosystem at a site. Instead, assessment endpoints focus the risk assessment on particular components of the ecosystem that could be adversely affected by chemicals from the site." Therefore, this ERA focuses on the endpoints tending to yield the highest risks, which should account for endpoints that have lower risks.

Piscivorous birds and mammals were not selected as assessment endpoint because piscivorous receptors are not expected to be present at the site since surface water is only expected to be present at the site part of the year in small standing water bodies. Large carnivorous birds and mammals were not selected as assessment endpoints because their home range (hundreds of acres) is larger than the site (approximately 12 acres). When the sizes of the sites are compared to the home ranges of top carnivores, such as the red-tailed hawk (approximately 1,700 acres) and the red fox (approximately 1,800 acres), carnivores would receive only a very small portion of their diet from site. Therefore, risks would be greater to small mammals and birds that obtain all or most of their food from the site. Although some reptiles (e.g., snakes) and amphibians may be present at the site, they were not selected as assessment endpoints because of the lack of toxicity information and the lack of methods to evaluate their exposure to chemicals.

1.5 <u>Conceptual Site Model</u>

A conceptual site model (CSM) in ERA problem formulation is a written description of predicted relationships between ecological entities and the stressors to which they may be exposed (USEPA, 1998). The CSM consists of two primary components: predicted relationships among stressor, exposure, and assessment endpoint response, and a diagram that illustrates the relationships (USEPA, 1998). At the site, the sources of the chemicals include VOCs, SVOCs, explosives including nitroglycerin, petroleum hydrocarbons, and metals associated within the former quarried disposal area, otherwise only metals and explosives including nitroglycerin are of concern beyond the disposal area. The exposure media includes surface soil, sediment, and groundwater. Surface water runoff carrying contaminated soil from the site or off-site areas may have led to contamination of sediment at the site. Groundwater data will be conservatively evaluated in the ERA because groundwater discharges into surface water and surface water samples have not been collected. Groundwater will be evaluated from wells MW-QRY-02, MW-QRY-03, and MW-QRY-09, which are located near drainage areas at the site. Because the site consists of different habitats such as vegetated areas and nearby area of seasonally standing water, a variety of terrestrial and aquatic receptors may be present at the site. For this ERA, surface soil will be defined as 0 to 1 foot and sediment as 0 to 6 inches. Note that in addition to the planned RI data collection, opportunity soil samples were collected during the MEC exploratory investigation of 2010, surface soil samples from the 2010 effort will be incorporated into the ERA data set,

2.0 Tier 1, Step 2: Screening-Level Exposure Estimate and Risk Quotients

2.1 Ecological Effects Evaluation

The preliminary ecological effects evaluation is an investigation of the relationship between exposure to a chemical and the potential for adverse effects resulting from exposure. In this step, conservative screening levels for evaluating the toxicity to ecological receptors from the detected levels of chemicals at the sites are compiled.

Terrestrial Plants and Soil Invertebrates

Risks to terrestrial plants and soil invertebrates resulting from direct exposure to chemicals will be evaluated by comparing the chemical concentrations in the surface soil to screening levels. In order of preference, the first source selected for the screening levels is the USEPA Ecological Soil Screening Levels (Eco SSLs) (http://www.epa.gov/ecotox/ecossl/). If an Eco SSL is not available for a particular chemical or receptor, then Canadian Soil Quality Guidelines (CCME) (http://ceqg-rcqe.ccme.ca/), followed

by Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for invertebrates (Efroymson et al., 1997a) and plants (Efroymson et al., 1997b), Ecotoxicology of Explosives (Sunahara et al., 2009), and ECORISK Database (Release 3.1) (LANL, 2012), and target values (MHSPE, 2000) will be used. Eco SSLs will be used first because they are the most current soil screening levels.

Sediment Invertebrates

Risks to sediment invertebrates resulting from direct exposure to chemicals will be evaluated by comparing the chemical concentrations in the sediment to screening levels. The screening levels consist of threshold effects concentrations (MacDonald, et al., 2000), followed by lowest effects levels (Persaud, et al., 1993), USEPA ecotox thresholds, sediment quality benchmarks (USEPA, 1996), National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables for freshwater sediment and marine sediment with values for freshwater sediment selected first (Buchman, 2008), secondary chronic values (Jones, et al., 1997), Region 5 ecological screening values for sediment (USEPA, 2003), and ECORISK Database (Release 3.1) (LANL, 2012).

Aquatic Organisms

Risks to aquatic organisms resulting from direct exposure to chemicals will be evaluated by comparing the chemical concentrations in the nearby groundwater to surface water screening levels. The screening levels consist of the Maine DEP surface water quality criteria (MEDEP, 2006), followed by USEPA National Recommended Water Quality Criteria, chronic freshwater values (USEPA, 2013), USEPA Region 3 Freshwater Screening Benchmarks (USEPA, July 2006), and NOAA Screening Quick Reference Tables for freshwater surface waters (Buchman, 2008).

Mammals and Birds

Potential risks to mammals and birds resulting from exposure to chemicals in the surface soil will be evaluated by comparing chemical concentrations to ecological screening levels. If a chemical concentration exceeds its screening level or a screening level is not available, the chemical will be evaluated using food chain models for risks to mammals and birds.

Risks to mammals and birds from exposures to chemicals in the surface soil will be determined by estimating the Chronic Daily Intake (CDI) and comparing the CDI to toxicity reference values (TRVs) representing acceptable daily doses in mg/kg-day. The TRVs, including no observed adverse effects levels (NOAELs), and lowest observed adverse effect levels (LOAELs) will be obtained from wildlife studies presented in the USEPA Eco SSLs (http://www.epa.gov/ecotox/ecossl/) and ORNL Toxicological

Benchmarks for Wildlife: 1996 Revision (Sample et al., 1996) and will be supplemented with other toxicity information when necessary. If a subchronic study is used to develop the TRV, the final value will be multiplied by a factor of 0.1 to account for uncertainty between subchronic and chronic effects. Also, the LOAEL will be multiplied by a factor of 0.1 to estimate a NOAEL TRV if only a LOAEL study is available. The chemical-specific Eco SSL documents provide both NOAELs and LOAELS for various studies, but TRVs are generally calculated only for NOAELs. The geometric mean of the chemical-specific growth and reproduction LOAELs from the chemical-specific Eco SSL documents will be used as the LOAEL TRVs for several metals. This approach will be used because the survival LOAELs tend to be greater than growth or reproductive LOAELs and the selected LOAELs are generally much lower than many NOAELs for growth, reproduction, and survival.

2.2 Exposure Characterization

Terrestrial soil invertebrates and plants are exposed to chemicals in the surface soil through direct contact and/or ingestion. Sediment invertebrates and aquatic organisms are exposed to chemicals in sediment and surface water through direct contact and/or ingestion. Maximum chemical concentrations in soil, sediment, and groundwater (assumed to be discharging to surface water, at least seasonally) will be used in the screening step to select chemicals of potential concern (COPCs). Only data from groundwater wells in close proximity to the surface water bodies and screened in the shallow zone that have the potential to discharge to the surface water will be included in the evaluation,

Doses in mg/kg-day will be estimated for terrestrial wildlife (mammals and birds) using exposure equations. The following equation will be used to calculate the exposure dose for terrestrial wildlife from exposure to chemicals in soil and associated food items (e.g., plants and invertebrates):

$$CDI = \frac{\left[\left(C_f * I_f\right) + \left(C_s * I_s\right)\right] * H}{BW}$$

Where:

CDI = chronic daily intake (mg/kg-day)

C_f = chemical concentration in food (mg/kg) (see discussion below)

C_s = chemical concentration in surface soil (mg/kg)

 I_f = food ingestion rate (kg/day)

I_s = incidental surface soil ingestion rate (kg/day)

H = portion of food intake from the contaminated area (unitless)

BW = body weight (kg)

The exposure assumptions (i.e., ingestion rate, body weight) will be obtained primarily from the Wildlife Exposure Factors Handbook (USEPA, 1993) with other sources used as necessary. Food ingestion rates will be presented on a dry weight basis and chemical concentrations in the food items will be estimated in dry weight concentrations. This will be done to be consistent with chemical concentrations in soil, which are reported on a dry weight basis. The drinking of surface water will not be included in the food chain model because surface water samples were not collected at the site, and the use of groundwater data would not be appropriate. Also, chemicals in surface water typically only contribute a small percentage of the CDI for mammals and birds. The exposure assumptions are presented in Table 2.

Chemical concentrations in food items for soil insectivorous and herbivorous receptors will be calculated using soil-to-invertebrate or soil-to-plant bioaccumulation factors (BAFs) or regression equations. The following equation will be used to calculate chemical concentrations in plants or invertebrates when BAFs are used:

$$C_f = C_s * BAF$$

Where:

 C_f = Chemical concentration in food (mg/kg)

C_s = Chemical concentration in surface soil (mg/kg)

BAF = Biota-soil bioaccumulation factor (unitless) (soil to plant or soil to earthworm)

The following sources of plants/earthworm BAFs will be used to calculate the chemical concentrations in plants and earthworms:

- Plant and invertebrate BAFs: Guidance for Developing Ecological Soil Screening Level (USEPA, 2007).
- Plant BAFs: ORNL Risk Assessment Information System (http://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef) (ORNL, 2013).
- BAFs for Explosives: Los Alamos National Laboratory (LANL) ECORISK Database (LANL, 2012)

A default value of 1.0 will be used for the BAF when chemical-specific data are not available.

The food chain model scenarios will be calculated using various exposure assumptions to present a range of potential risks. For selection of chemicals as COPCs, the following set of conservative exposure assumptions will be used:

- Maximum soil concentrations
- Conservative receptor body weight and ingestion rates
- Receptors spend 100 percent of their time at the Site

2.3 Risk Characterization

An Ecological Effects Quotient (EEQ) approach will be used to characterize the risk to ecological receptors. This approach characterizes the potential effects by comparing exposure concentrations with the effects data. When EEQs exceed 1.0, it is an indication that ecological receptors are potentially at risk, although additional evaluation or data may be necessary to confirm with greater certainty whether ecological receptors are actually at risk, especially because most benchmarks are developed using conservative exposure assumptions and/or studies. An EEQ should not be construed as being probabilistic; rather, it is a numerical indicator of the extent to which an EPC exceeds or is less than a benchmark.

The EEQs for surface soil receptors will be calculated as follows:

$$\mathsf{EEQ} = \frac{\mathsf{Css}}{\mathsf{SSSL}}$$

where:

EEQ = Ecological Effects Quotient (unitless)

Css = Chemical concentration in surface soil (µg/kg or mg/kg)

SSSL = Surface soil screening level (µg/kg or mg/kg)

The EEQs for sediment invertebrates will be calculated as follows:

$$EEQ = \frac{Csd}{SdSL}$$

where:

EEQ = Ecological Effects Quotient (unitless)

Csd = Chemical concentration in sediment (µg/kg or mg/kg)

SdSL = Sediment screening level (μ g/kg or mg/kg)

The EEQs for aquatic organisms will be calculated as follows:

$$EEQ = \frac{Cgw}{SwSL}$$

where:

EEQ = Ecological Effects Quotient (unitless)

Csd = Chemical concentration in groundwater (µg/L)

SwSL = Surface water screening level (μ g/L)

The EEQs for mammals and birds will be calculated as follows:

$$EEQ = \frac{CDI}{TRV}$$

where:

EEQ = Ecological effects quotient (unitless)CDI = Chronic daily intake dose (mg/kg-day)

TRV = Toxicity reference value (NOAEL or LOAEL) (mg/kg-day)

2.4 Selection of Chemicals of Potential Concern

The final part of the screening evaluation includes the initial selection of ecological COPCs. Chemicals that are not retained as COPCs are assumed to only cause negligible risk to ecological receptors and will not be evaluated further in the ERA. Chemicals that are initially selected as COPCs will be further evaluated in Step 3a to determine if they will be retained as final COPCs. The initial ecological COPCs will be selected by the following procedures:

- For plants, soil invertebrates, sediment invertebrates, and aquatic organisms, chemicals with EEQs greater than 1.0 (using screening values) will be selected as COPCs because they have a potential to cause risk to ecological receptors.
- If a contaminant has a maximum detected concentration that exceeds associated soil screening level for birds or mammals or a screening level is not available then the chemical will be retained for food chain modeling for wildlife. For VOCs, only incidental ingestion of soil will be evaluated; bioaccumulation into food items will be not evaluated for VOCs based on an agreement with U. S. EPA Region I. For birds and mammals, chemicals with EEQs greater than 1.0 based on the food

chain model using NOAELs will be selected as COPCs because they have the potential to cause risks to higher trophic level mammals and birds.

- Chemicals without screening values will be selected as COPCs, but only evaluated qualitatively.
- Calcium, magnesium, potassium, and sodium will not be selected as COPCs, because they are
 essential nutrients that can be tolerated by living systems even at high concentrations. No
 evidence indicates that these chemicals are related to site operations, and they are not
 considered hazardous chemicals.

3.0 Tier 2, Step 3a: COPC Refinement

The purposes of Step 3a are to re-evaluate the COPCs that are retained from Tier 1 for further evaluation in a Tier 2 BERA and to identify and eliminate from further consideration those chemicals that are only selected as COPCs because of the use of very conservative exposure scenarios. Using less conservative (but more realistic) assumptions, the Tier 1 risk estimates will be recalculated and the new estimates will be used to refine the list of COPCs identified by the Tier 1 screening risk assessment in order to focus any additional efforts on chemicals that are of primary ecological concern.

For chemicals that are evaluated further in Step 3a, the following factors will be evaluated, as appropriate, to determine if the risks are great enough to warrant additional evaluations. Note that all of these factors might not be applicable for each chemical and/or receptor group.

- Magnitude of criterion exceedance: Although the magnitude of the risks may not relate directly to the
 magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item
 used in a lines-of-evidence approach to determine the need for further site evaluation. The greater
 the criterion exceedance, the greater the probability and concern that an unacceptable risk exists.
- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at higher frequency if toxicity values, concentrations, and spatial areas represented by the data are similar. All else being equal, chemicals detected frequently will be given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical may be evaluated to determine the area that a sample, or samples, represents.
- Background: Concentrations of chemicals in surface soil will be compared to background concentration data if available. If the concentration of a detected chemical is not greater than the background concentration, the chemical will be considered as not site-related and eliminated as a

COPC. Site data will be compared to background using lines-of-evidence such as site-specific facility background data for applicable metals, pesticides, and PAHs or the MEDEP background PAH values which are included in Maine's Remedial Action Guidelines (RAGs) Appendix 1 and 2 tables (MEDEP, 2013). For PAHs, the site-specific facility background data represents natural rather than anthropogenic conditions and so available facility background values may be used for portions of the Quarry site while for other portions of the Quarry site comparisons to Maine's Rural Developed category for PAHs may be considered instead.

Several categories of facility background data are available. The facility background categories that will be used to match the varied site conditions, based on investigation results to date and to be refined following evaluation of the RI lithology data, where the munitions response site (MRS) is defined as the original Preliminary Assessment (PA) site boundary central to the site, are as follows:

For surface soil:

- "Mixed Soil" for surface soil within the Quarry/MRS boundary
- "Mixed Soil" for surface soil between MRS and Old Route 24 and east of the MRS
- "Upper Sand" for surface soil south of Old Route 24 and north of Radio Tower
 Access Road

It is recognized that a few samples within each area could individually have a differing designation than the overall given area. If these samples differing in soil type from the overall area have concentrations that exceed both background and maximum concentration for the remainder of the area, the data will be further evaluated to determine whether the chemical concentration is greater than background for that area. Otherwise, these samples will be designated as part of the area as a whole and screened against background for that area.

For groundwater:

Discharge to surface water, background categories can be classified by area: the wells in the northeastern portion of the site would fall under "Upper Sand Fall/Spring", whereas the rest of the site would be "Bedrock Fall/Spring". Specifically for the ERA, groundwater data, collected in the Fall, will be evaluated from wells MW-QRY-02, MW-QRY-03, and MW-QRY-09, which are located near drainage areas at the site, and so the following categories apply:

- "Upper Sand Fall" would apply to wells MW-QRY-03 and -09
- "Bedrock Fall" would apply to well MW-QRY-02
- Contaminant bioavailability: Many contaminants (especially inorganics) are present in the
 environment in forms that are typically not bioavailable, and the limited bioavailability will be
 considered when evaluating the exposures of receptors to site contaminants. Contaminants with

generally less bioavailability will be considered to be less toxic than the more bioavailable contaminants, all other factors being equal.

- Additional Benchmarks: Alternative benchmarks will be used to further evaluate risks to specific groups of ecological receptors (e.g., plants and invertebrates). Several of the sediment risk screening levels [e.g., threshold effects concentrations (TECs)] that will be used to select COPCs are conservative because chemicals detected at concentrations below these levels are not expected to cause any adverse impacts to the benthic community. Since the objective of the risk screening will be to determine if the chemicals at the site are causing a risk to ecological receptors, higher effect benchmarks [e.g., probable effects concentrations (PECs)] will be used to further evaluate risks to sediment invertebrates from chemicals that exceeded conservative screening levels.
- Food Chain Modeling: Exposure via the food chain is a major pathway of concern for chemicals known to significantly bioaccumulate and/or biomagnify. Thus, potential risk to upper level receptors is evaluated using food chain models. The Tier 1 exposure doses calculated for terrestrial wildlife will be re-calculated using the following Tier 2, Step 3A exposure assumptions and chemical concentrations:
 - Average soil concentrations
 - Average receptor body weights and ingestion rates

REFERENCES

Buchman, M. F., 2008. NOAA Screening Quick Reference Tables, NOAA OR&R Report 08-1, Seattle, WA, Office of Response and Restoration Division, National Oceanic and Atmospheric Administration, 34 pages. http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html

Efroymson, R.A., M.E. Will, and G.W. Suter II, 1997a. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten, 1997b. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. November. ES/ER/TM-85/R3.

Jones, D.S., R.N. Hull, and G.W. Suter II, 1997. <u>Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision.</u> Risk Assessment Program, Health Sciences Division, Oak Ridge, Tennessee. ES/ER/TM-95/R4. November.

Los Alamos National Laboratory (LANL), 2012 (October). ECORISK Database (Release 3.1). LA-UR-12-24548. Los Alamos National Laboratory, Los Alamos, New Mexico.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems." Archives of Environmental Contamination and Toxicology, Vol. 39, pp. 20-31.

MEDEP (Maine Department of Environmental Protection), 2006. Surface Water Quality Criteria for Toxic Pollutants. Chapter 584. Effective September 18, 2006.

MHSPE, 2000. Circular on target values and intervention values for soil remediation. Ministry of Housing, Spatial Planning and Environment. DBO/1999226863. Department of Soil Protection, The Netherlands. February 4.

Navy (Department of the Navy), 1999. Navy Policy For Conducting Ecological Risk Assessments. Memo from Chief of Naval Operations to Commander, Naval Facilities Engineering Command, 05 April 1999. Department of the Navy, Washington, DC.

ORNL (Oak Ridge National Laboratory). 1998. <u>Empirical Model for the Uptake of Inorganic Chemicals from Soil by Plants.</u> BJC/OR-133. September.

ORNL, 2013. Chemical Specific Parameters. Oak Ridge National Laboratory Web Page, http://rais.ornl.gov/cgi-bin/tools/TOX_search?select=chem_spef. Accessed January 17.

Persaud, D., R. Jaagumagi, and A. Hayton. 1993. <u>Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario.</u> Ontario Ministry of Environment and Energy. August.

Sample, B.E., D.M. Opresko, and G.W. Suter II, 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Oak Ridge National Laboratory. June. ES/ER/TM-86/R3.

Sunahara, G.I., G.R. Lotufo, R.G Kuperman, and J. Hawari, 2009. Ecotoxicology of Explosives. CRC Press, Taylor and Francis Group. 2009.

USEPA (U.S. Environmental Protection Agency), 1993. Wildlife Exposure Factors Handbook. Office of Research and Development. Washington, D.C. EPA/600/R-93/187a. December.

USEPA, 1996. <u>ECO Update, Ecotox Thresholds</u>. U.S. Environmental Protection Agency. Office of Solid Waste and Emergency Response. Intermittent Bulletin, Volume 3, Number 2. EPA540/F-95/038. January.

USEPA, 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. Environmental Response Team. June 5.

USEPA, 1998. Final Guidelines for Ecological Risk Assessment. Risk Assessment Forum, Washington, DC, EPA/630/R095/002F. April.

USEPA, 2003. <u>Ecological Screening Levels</u>. USEPA Region 5 (http://www.epa.gov/reg5rcra/ca/edql.htm). August.

USEPA, 2004. <u>The Incidence and Severity of Sediment Contamination in Surface Waters of the United States, Volume 1:National Sediment Quality Survey: Second Edition</u>. Office of Science and Technology. Washington, D.C. EPA 823-R-04-007. November.

USEPA, 2006. Region 3 Freshwater Surface Water Screening Benchmarks. July. http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fw/screenbench.htm

USEPA, 2007. Guidance for Developing Ecological Soil Screening Level, Attachment 4-1, Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSLs. Office of Solid Waste and Emergency and Response. OSWER Directive 9285.7-55. April.

USEPA, 2013. <u>National Recommended Water Quality Criteria: 2013</u>. Office of Water. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm

TABLE 1

ASSESSMENT ENDPOINTS AND MEASUREMENT ENDPOINTS ECOLOGICAL RISK ASSESSMENT METHODOLOGY FORMER NAS BRUNSWICK BRUNWICK, MAINE

Assessment Endpoint	Measurement Endpoint				
Adverse effects on the survival, reproduction, and/or growth of terrestrial plants	 Survival, growth, and/or reproduction of terrestrial plants will be evaluated by comparing the measured concentrations of chemicals in the surface soil to plant soil screening levels. 				
Adverse effects on the survival, reproduction, and/or growth of soil invertebrates	 Survival, growth, and/or reproduction of soil invertebrates will be evaluated by comparing the measured concentrations of chemicals in the surface soil to invertebrate soil screening levels. 				
Adverse effects on the survival, reproduction, and/or growth of sediment invertebrates	 Survival, growth, and/or reproduction of sediment invertebrates will be evaluated by comparing the measured concentrations of chemicals in the sediment to sediment screening levels. 				
Adverse effects on the survival, reproduction, and/or growth of aquatic organisms	 Survival, growth, and/or reproduction of aquatic organisms will be evaluated by comparing the measured concentrations of chemicals in surface water and the groundwater potentially discharging to surface water to surface water screening levels. 				
Adverse effects on the survival, reproduction, and/or increase in development effects of insectivorous birds and mammals	 Survival, reproduction, and/or increase in development effects of birds and mammals will be evaluated by comparing the estimated ingested dose of contaminants in the surface soil and earthworms to No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs) for surrogate wildlife species. 				
Adverse effects on the survival, reproduction, and/or increase in development effects of herbivorous birds and mammals	 Survival, reproduction, and/or increase in development effects of birds and mammals will be evaluated by comparing the estimated ingested dose of contaminants in the surface soil and plants to NOAELs and LOAELs for surrogate wildlife species. 				

TABLE 2

EXPOSURE PARAMETERS FOR THE TERRESTRIAL WILDLIFE MODEL ECOLOGICAL RISK ASSESSMENT METHODOLOGY FORMER NAS BRUNSWICK BRUNSWICK, MAINE

	Conservative Inputs		Average Inputs		
Species/Exposure Inputs	Values	Units	Values	Units	
Meadow Vole					
Body Weight = BW	1.700E-02	kg	3.580E-02	kg	
Food Ingestion Rate = If	1.878E-03	kg/day	1.744E-03	kg/day	
Water Ingestion Rate = Iw	7.513E-03	L/day	6.261E-03	L/day	
Soil Ingestion Rate = Is	6.010E-05	kg/day	2.093E-05	kg/day	
Home Range = HR	Assume 100%	on site	6.590E-02	acres	
Bobwhite Quail					
Body Weight = BW	1.540E-01	kg	1.751E-01	kg	
Food Ingestion Rate = If	1.628E-02	kg/day	1.361E-02	kg/day	
Water Ingestion Rate = Iw	2.276E-02	L/day	1.926E-02	L/day	
Soil Ingestion Rate = Is	2.263E-03	kg/day	8.302E-04	kg/day	
Home Range = HR	Assume 100% on site		1.880E+01	acres	
Short-Tailed Shrew					
Body Weight = BW	1.500E-02	kg	1.610E-02	kg	
Food Ingestion Rate = If	1.600E-03	kg/day	1.433E-03	kg/day	
Water Ingestion Rate = Iw	4.280E-03	L/day	3.600E-03	L/day	
Soil Ingestion Rate - Is	4.801E-05	kg/day	1.289E-05	kg/day	
Home Range = HR	Assume 100%	on site	9.699E-01	acres	
American Robin					
Body Weight = BW	7.73E-02	kg	8.04E-02	kg	
Food Ingestion Rate = If	1.25E-02	kg/day	1.19E-02	kg/day	
Water Ingestion Rate = Iw	1.21E-02	L/day	1.13E-02	L/day	
Soil Ingestion Rate - Is	2.05E-03	kg/day	7.60E-04	kg/day	
Home Range = HR	Assume 100%	on site	6.10E-01	acres	

Notes:

The soil ingestion rates were calculated by multiplying the food ingestion rates by the following incidental soil ingestion rates:

	Conservative	Average	Source
Meadow Vole	3.2%	1.2%	1
Bobwhite quail	13.9%	6.1%	1, 2
Short-tailed Shrew	3%	0.90%	1
American Robin	16.40%	6.40%	1, 3

- 1 U.S. EPA (U.S. Environmental Protection Agency), 2007. Ecological Soil Screening Level Guidance, Office of Emergency and Remedial Response. February.
- 2 Based on the mourning dove.
- 3 Based on the American woodcock.

APPENDIX F

BEDROCK FRACTURE TRACE ANALYSIS REPORT

BEDROCK FRACTURE TRACE ANALYSIS REPORT QUARRY AREA AND SITE 12 EOD AREA FORMER NAVAL AIR STATION BRUNSWICK BRUNSWICK. MAINE

This field report summarizes and evaluates the results of fracture trace analysis of the Quarry Area and at Site 12 Explosive Ordnance Disposal (EOD) Area located at the former Naval Air Station (NAS) Brunswick in Brunswick, Maine. This report was prepared by Tetra Tech under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62470-08-D-1001, Contract Task Order (CTO) WE09, which is part of the Navy's Environmental Restoration Program (ERP). The purpose of this analysis is to support the location of proposed monitoring wells and surface geophysics.

The analysis included delineation of photo-lineaments, and measurement of the orientation (strike and dip) of 174 planar features using a Brunton compass corrected for local magnetic declination (17 degrees west). Field work was performed on July 9-10, 2012. Rose diagrams and stereonets are provided for all fractures measured and include sub-categories (e.g., foliation, joints). Rose diagrams show the strike (direction relative to true north) of each planar feature and stereonets show the three-dimensional orientation of planar features. Each point on the stereonet represents the intersection of the lower hemisphere of a sphere with a line normal to a planar feature. The results of the bedrock fracture trace analysis are presented below:

Quarry Area

Results

- Photo-lineaments and bedrock outcrops where bedrock fractures were measured, and proposed monitoring well locations in the vicinity of the Quarry are shown on Figure 1.
- The strike and dip of 75 fractures were measured including 40 foliation planes and 35 joints in the Cushing Formation. The direction and inclination of 75 fractures are shown on the rose diagram and stereonet on Figure 2.
- The primary direction of planar features is represented by high-angle foliation planes that strike north-northeast and dip southeast (Figure 3). The strike of foliation coincides with the north-northeast direction of photo-lineaments surrounding the Quarry.
- The secondary direction is represented by high angle joints that generally strike approximately west-northwest and dip to the north-northeast and southsouthwest (Figure 4). Several photo-lineaments located north and south of the Quarry coincide with the west-northwest strike of joints.

Conclusions/Recommendations

- Bedrock fracture trace analysis supports the original presumption that groundwater in the overburden in the vicinity of the Quarry is expected to follow surface drainage toward the south and west.
- Based on the fracture trace analysis, groundwater in shallow fractured bedrock should flow preferentially in a south-southwest and west-northwest direction from the Quarry and follow surface drainage patterns.
- Based on the fracture trace analysis and bedrock drilling experience at NAS Brunswick, the proposed monitoring wells are suitably located in the general areas that should intersect potential groundwater migration pathways in the overburden and shallow fractured bedrock. However, at this time, it is recommended that the monitoring well installation be conducted to gather information to determine the degree of subsurface fracturing and whether foliation and joints are significant groundwater migration pathways based on bedrock coring, monitoring well gauging and groundwater/surface water sampling results. Upon evaluation of the monitoring well boring logs and analytical results the team will confer to determine the path forward, including the need for geophysics.

Site 12 EOD Area

Results

- Photo-lineaments and bedrock outcrops where bedrock fractures were measured, and proposed monitoring well locations in the vicinity of the Site 12 EOD Area are shown on Figure 5.
- The strike and dip of 99 planar features were measured including 21 schistosity planes and 21 joints in Cape Elizabeth Formation; 43 joints in granite/pegmatite sills, and 14 contacts between the Cape Elizabeth schist and the pegmatite sills.
- The composite diagram (Figure 6) shows the primary north-northeast strike and east-southeast dip (schistosity/foliation), and secondary orientations (joints).
 These results are similar to that in a report by Gannet Fleming for the U.S. Environmental Protection Agency (EPA) dated January 22, 2003.
- Joints in the Cape Elizabeth schist are generally moderate to high angle that strike approximately west-northwest and dip to the east-southeast or westsouthwest (Figure 7) are similar to the Gannet Fleming findings. No photolineaments located in the vicinity of the Site 12 EOD Area coincide with the westnorthwest strike of joints.
- Cape Elizabeth schistosity planes are high angle (54-90 degrees) that strike north-northeast and dip to the east-southeast (Figure 8) are similar to the Gannet

08/02/12

Fleming results. The direction of numerous photo-lineaments surrounding the Site 12 EOD area is similar to the strike of Cape Elizabeth schistosity.

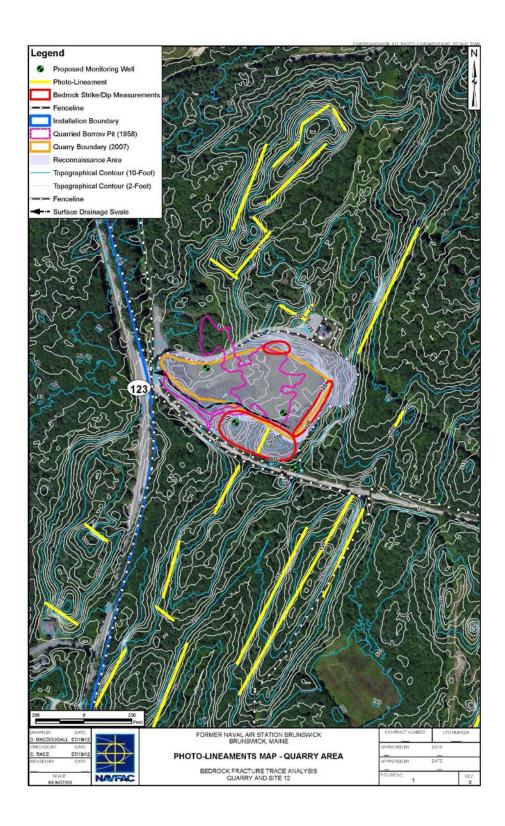
- Contacts between Cape Elizabeth schist and pegmatite sills are high angle that strike north-northeast and dip east-southeast (Figure 9) parallel to schistosity. Several granite/pegmatite sills crop out across the Site 12 EOD Area, west, east, and north of the pond. The thickness of granite/pegmatite sills varies from 1.5 feet at a ridge in the western portion of Site 12 to over 8 feet at some outcrops near the fence east of the pond. These measurements were not discussed by Gannet Fleming. Granite/pegmatite sills observed in the vicinity of Site 12 EOD Area are of low relief and are generally not expressed as ridges in the topography, except along the east margin of the pond located in the eastern portion of the Site 12 EOD Area.
- Joints in the pegmatite are generally moderate to high angle that strike and dip in several directions (Figure 10). Sub-horizontal sheeting joints were observed in pegmatite outcrops with several feet of relief. These results were similar to those of Gannet Fleming and more pronounced due to a higher number of pegmatite joint measurements (43 versus 14). Several photo-lineaments located in the vicinity of the Site 12 EOD Area differ from the west-northwest strike of pegmatite joints.

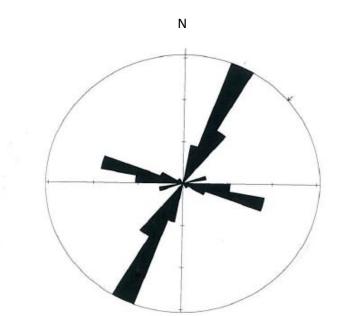
Conclusions/Recommendations

- Shallow groundwater in the overburden in the vicinity of the former EOD berm area targeted for monitoring wells is expected to follow surface drainage generally to the north and west directions from the EOD berm area. A bedrock ridge that crops out along the road located between the EOD berms and the pond that may act as a groundwater divide separating groundwater flow to the west and the east.
- Based on the fracture trace analysis, groundwater in shallow fractured bedrock should flow through interconnected fractures preferentially in north-northeast and west-northwest directions from the EOD berms follow surface drainage. The granite/pegmatite sills outcrops located in the vicinity of Site 12 contain joints in several directions are probably interconnected with sub-horizontal sheeting fractures and may act as a preferential groundwater migration pathway. Gannet Fleming suggested "pegmatite sills may serve to impede horizontal and vertical groundwater flow more than a wholly Cape Elizabeth ridge" at Site 11; this is not expected to be the situation at Site 12.
- Based on the fracture trace analysis and bedrock drilling experience at NAS
 Brunswick, the proposed monitoring wells are suitably located in the general
 areas that should intersect potential groundwater migration pathways in the
 overburden and shallow fractured bedrock. However, at this time, it is

recommended that the monitoring well installation be conducted to gather information to determine the degree of subsurface fracturing and whether foliation and joints are significant groundwater migration pathways based on bedrock coring, monitoring well gauging and groundwater/surface water sampling results. Upon evaluation of the monitoring well boring logs and analytical results the team will confer to determine the path forward, including the need for geophysics.

FIGURES





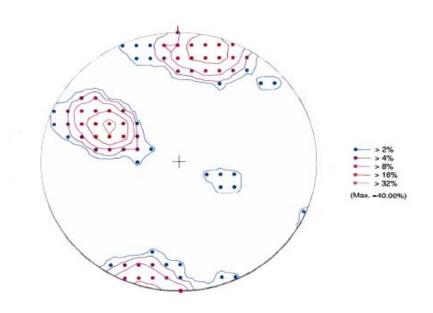


FIGURE 2
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

QUARRY AREA - ROSE DIAGRAM AND STEREONET OF 75 PLANAR FEATURES (COMPOSITE)

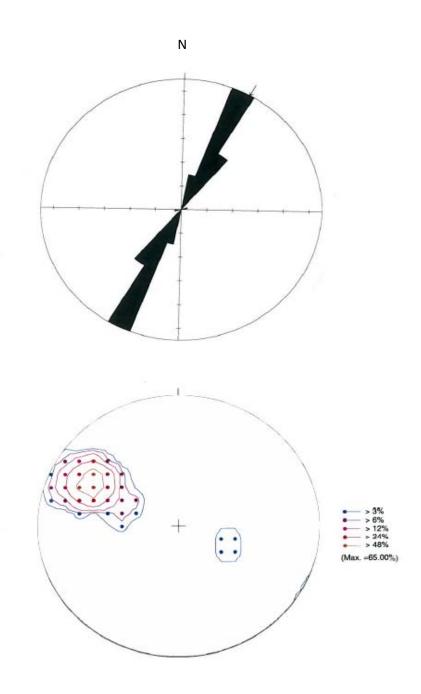


FIGURE 3
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

QUARRY AREA - ROSE DIAGRAM AND STEREONET OF 40 PLANAR FEATURES (FOLIATION)

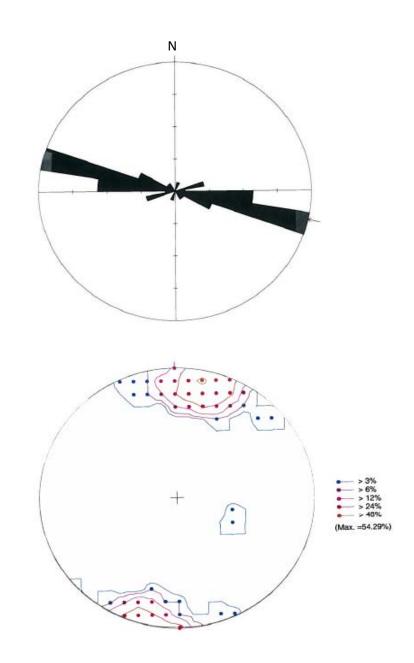
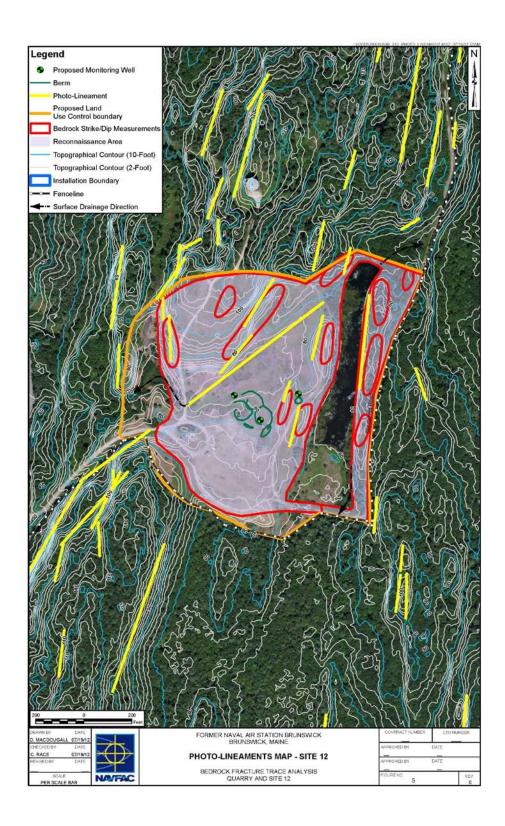


FIGURE 4
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

QUARRY AREA - ROSE DIAGRAM AND STEREONET OF 35 PLANAR FEATURES (JOINTS)



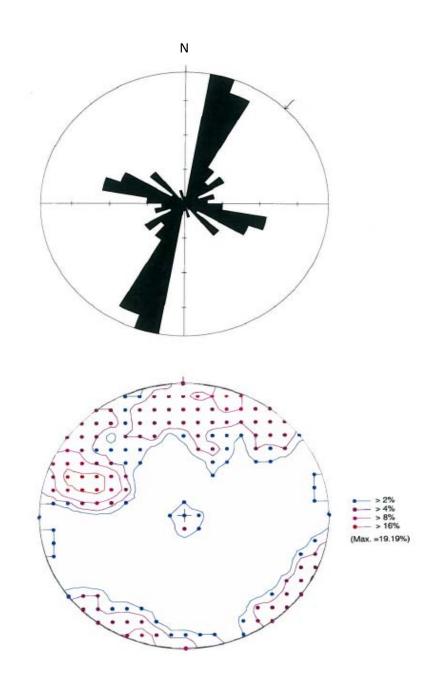


FIGURE 6
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

SITE 12 – ROSE DIAGRAM AND STEREONET OF 99 PLANAR FEATURES (COMPOSITE)

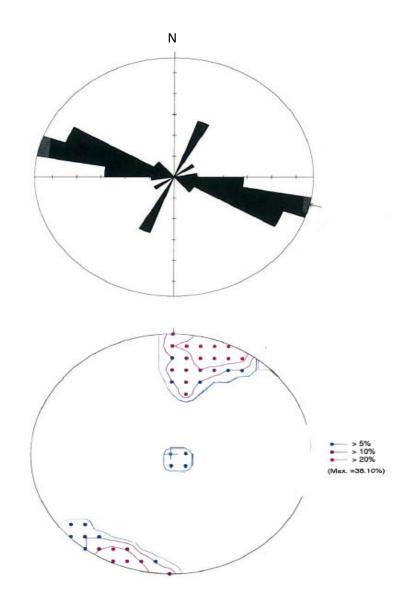


FIGURE 7

FORMER NAVAL AIR STATION BRUNSWICK BRUNSWICK, MAINE

SITE 12 – ROSE DIAGRAM AND STEREONET OF 21 PLANAR FEATURES (CAPE ELIZABETH JOINTS)

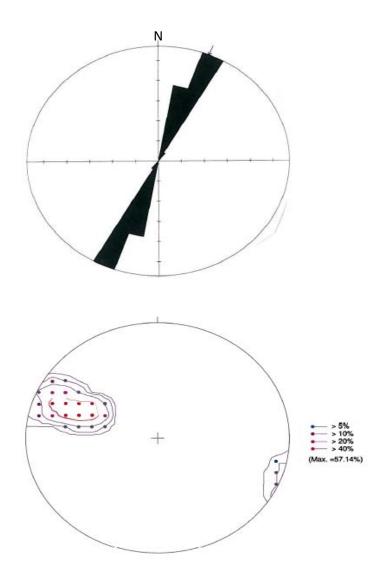


FIGURE 8

FORMER NAVAL AIR STATION BRUNSWICK BRUNSWICK, MAINE

SITE 12 – ROSE DIAGRAM AND STEREONET OF 21 PLANAR FEATURES (CAPE ELIZABETH SCHISTOSITY)

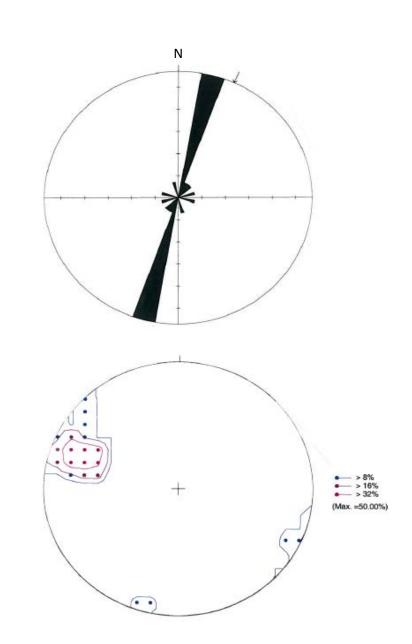


FIGURE 9 FORMER NAVAL AIR STATION BRUNSWICK BRUNSWICK, MAINE

SITE 12 – ROSE DIAGRAM AND STEREONET OF 14 PLANAR FEATURES (CAPE ELIZABETH/GRANITE CONTACT)

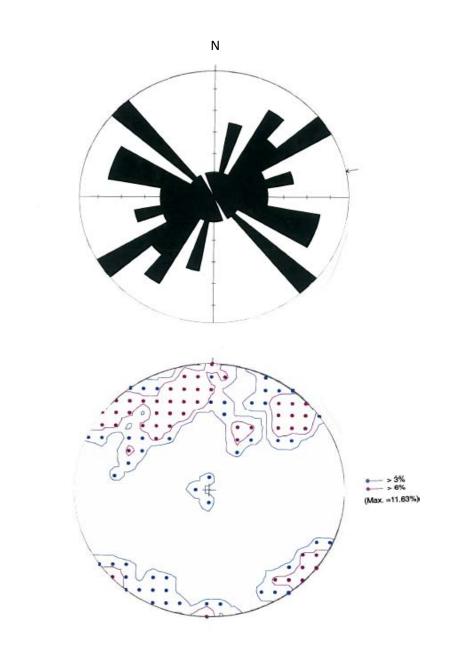


FIGURE 10
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

SITE 12 – ROSE DIAGRAM AND STEREONET OF 43 PLANAR FEATURES (GRANITE JOINTS)

APPENDIX G

SITE-SPECIFIC FIELD STANDARD OPERATING PROCEDURES



INC.

STANDARD OPERATING PROCEDURES

Number	Page
CT-04	1 of 7
Effective Date	Revision
03/09/09	2

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Subject

SAMPLE NOMENCLATURE

Approved

Tom Johnston



TABLE OF CONTENTS

SECT	<u>ION</u>		<u>PAGE</u>
1.0	PURP	OSE	2
2.0	SCOP	E	2
3.0	GLOS	SARY	2
4.0	RESPO	ONSIBILITIES AND PERSONNEL QUALIFICATIONS	2
5.0	PROC	EDURES	3
	5.1 5.2 5.3 5.4 5.5 5.6	INTRODUCTIONSAMPLE IDENTIFICATION FIELD REQUIREMENTS	3 5 6
6.0	DEVIA	TIONS	

Subject	Number	Page
	CT-04	2 of 7
SAMPLE NOMENCLATURE	Revision	Effective Date
	2	03/09/09

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to specify a consistent sample nomenclature system that will facilitate subsequent data management in a cost-effective manner. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by matrix
- Sorting of data by depth
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints (maximum of 20 characters)

2.0 SCOPE

The methods described in this SOP shall be used consistently for all projects requiring electronic data. Other contract- or project-specific sample nomenclature requirements may also be applicable.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

<u>Program Manager</u> - It shall be the responsibility of the Project Manager (or designee) to inform contractspecific Project Managers (PMs) of the existence and requirements of this SOP.

<u>Project Manager</u> - It shall be the responsibility of the PM to determine the applicability of this SOP based on: (1) program-specific requirements and (2) project size and objectives. It shall be the responsibility of the PM (or designee) to ensure that sample nomenclature requirements are thoroughly specified in the relevant project planning document (e.g., sampling and analysis plan) and are consistent with this SOP if relevant. It shall be the responsibility of the PM to ensure that the FOL is familiar with the sample nomenclature system.

<u>Field Operations Leader (FOL)</u> - It shall be the responsibility of the FOL to ensure that all field technicians or sampling personnel are thoroughly familiar with this SOP and the project-specific sample nomenclature system. It shall be the responsibility of the FOL to ensure that the sample nomenclature system is used during all project-specific sampling efforts.

General personnel qualifications for sample nomenclature activities in the field include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather)
 conditions.
- Familiarity with appropriate procedures for field documentation, handling, packaging, and shipping.

Subject	Number CT-04	Page 3 of 7
SAMPLE NOMENCLATURE	Revision 2	Effective Date 03/09/09

5.0 PROCEDURES

5.1 <u>INTRODUCTION</u>

The sample identification (ID) system can consist of as few as eight but not more than 20 distinct alphanumeric characters. The sample ID will be provided to the laboratory on the sample labels and chain-of-custody forms. The basic sample ID provided to the laboratory has three segments and shall be as follows, where "A" indicates "alpha," and "N" indicates "numeric":

A or N	AAA	A or N
3 or 4 Characters	2 or 3 Characters	3 to 6 Characters
Site Identifier	Sample Type	Sample Location

Additional segments may be added as needed. For example:

(1) Soil and sediment sample ID

A or N	AAA	A or N	NNNN
3 or 4 Characters	2 or 3 Characters	3 to 6 Characters	4 Characters
Site identifier	Sample type	Sample location	Sample depth

(2) Aqueous (groundwater or surface water) sample ID

A or N	AAA	A or N	NN	-A
3 or 4 Characters	2 or 3 Characters	3 to 6 Characters	2 Characters	1 Character
Site identifier	Sample type	Sample location	Round number	Filtered sample only

(3) Biota sample ID

A or N	AAA	A or N	AA	NNN
3 or 4 Characters	2 or 3 Characters	3 to 6 Characters	2 Characters	3 Characters
Site identifier	Sample type	Sample location	Species identifier	Sample group number

5.2 SAMPLE IDENTIFICATION FIELD REQUIREMENTS

The various fields in the sample ID include but are not limited to the following:

- Site identifier
- Sample type
- Sample location
- Sample depth
- Sampling round number
- Filtered
- Species identifier
- Sample group number

Subject	Number	Page
	CT-04	4 of 7
SAMPLE NOMENCLATURE	Revision	Effective Date
	2	03/09/09

The site identifier must be a three- or four-character field (numeric characters, alpha characters, or a mixture of alpha and numeric characters may be used). A site number is necessary because many facilities/sites have multiple individual sites, Solid Waste Management Units (SWMUs), Operable Units (OUs), etc. Several examples are presented in Section 5.3 of this SOP.

The sample type must be a two- or three-character alpha field. Suggested codes are provided in Section 5.3 of this SOP.

The sample location must be at least a three-character field but may have up to six characters (alpha, numeric, or a mixture). The six characters may be useful in identifying a monitoring well to be sampled or describing a grid location.

The sample depth field is used to note the depth below ground surface (bgs) at which a soil or sediment sample is collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. If the sample depth is equal to or greater than 100, then only the top interval would be represented and the sampling depth would be truncated to three characters. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet or boring log, in the logbook, etc.

A two-digit round number will be used to track the number of aqueous samples collected from a particular aqueous sample location. The first sample collected from a location will be assigned the round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Aqueous samples that are field filtered (dissolved analysis) will be identified with an "-F" in the last field segment. No entry in this segment signifies an unfiltered (total) sample.

The species identifier must be a two-character alpha field. Several suggested codes are provided in Section 5.3 of this SOP.

The three-digit sample group number will be used to track the number of biota sample groups (a particular group size may be determined by sample technique, media type, the number of individual caught, weight issues, time, etc.) by species and location. The first sample group of a particular species collected from a given location will be assigned the sample group number 001, and the second sample group of the same species collected from the same location will be assigned the sample group number 002.

5.3 EXAMPLE SAMPLE FIELD DESIGNATIONS

Examples of each of the fields are as follows:

Site identifier - Examples of site numbers/designations are as follows:

A01 - Area of Concern (AOC) 1

125 - SWMU 125

000 - Base- or facility-wide sample (e.g., upgradient well)

BBG - Base background

The examples cited are only suggestions. Each PM (or designee) must designate appropriate (and consistent) site designations for their individual project.

Sample type - Examples of sample types are as follows:

AH - Ash Sample

Subject	Number CT-04	Page 5 of 7
SAMPLE NOMENCLATURE	Revision 2	Effective Date 03/09/09

AS - Air Sample

BM - Building Material Sample
BSB - Biota Sample Full Body
BSF - Biota Sample Fillet
CP - Composite Sample

CS - Chip Sample
DS - Drum Sample
DU - Dust Sample
FP - Free Product

IDW - Investigation-Derived Waste Sample

LT - Leachate Sample

MW - Monitoring Well Groundwater Sample

OF - Outfall Sample

RW - Residential Well Sample

SB - Soil Boring Sample
SD - Sediment Sample
SC - Scrape Sample
SG - Soil Gas Sample
SL - Sludge Sample

SP - Seep Sample

SS - Surface Soil Sample

ST - Storm Sewer Water Sample

SW - Surface Water Sample

TP - Test Pit Sample

TW - Temporary Well Sample

WC - Well Construction Material Sample

WP - Wipe Sample
WS - Waste/Solid Sample
WW - Wastewater Sample

Sample location - Examples of the location field are as follows:

001 - Monitoring well 1

N32E92 - Grid location 32 North and 92 East

D096 - Investigation-derived waste drum number 96

Species identifier - Examples of species identifier are as follows:

BC - Blue Crab
GB - Blue Gill
CO - Corn
SB - Soybean

5.4 EXAMPLES OF SAMPLE NOMENCLATURE

The first round monitoring well groundwater sample collected from existing monitoring well 001 at SWMU 16 for a filtered sample would be designated as 016MW00101-F.

The second round monitoring well groundwater sample collected from existing monitoring well C20P2 at Site 23 for an unfiltered sample would be designated as 023MWC20P202.

The second surface water sample collected from point 01 at SWMU 130 for an unfiltered sample would be designated as 130SW00102.

Subject	Number	Page
	CT-04	6 of 7
SAMPLE NOMENCLATURE	Revision	Effective Date
	2	03/09/09

A surface soil sample collected from grid location 32 North and 92 East at Site 32 at the 0- to 2-foot interval would be designated as 032SSN32E920002.

A subsurface soil sample from soil boring 03 at SWMU 32 at an interval of 4 to 5 feet bgs would be designated as 032SB0030405.

A sediment sample collected at SWMU 19 from 0 to 6 inches at location 14 would be designated as 019SD0140001. The sample data sheet would reflect the precise depth at which this sample was collected.

During biota sampling for full-body analysis, the first time a minnow trap was checked at grid location A25 of SWMU 1415, three small blue gills were captured, collected, and designated with the sample ID of 1415BSBA25BG001. The second time blue gill were collected at the same location (grid location A25 at SWMU 1415), the sample ID would be 1415BSBA25BG002.

Note: No dash (-) or spacing is used between the segments with the exception of the filtered segment. The "F" used for a filtered aqueous sample is preceded by a dash (-F).

5.5 FIELD QA/QC SAMPLE NOMENCLATURE

Field Quality Assurance (QA)/Quality Control (QC) samples are designated using a different coding system. The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNN	NN	-F
QC type	Date	Sequence number	Filtered
		(per day)	(aqueous only, if needed)

The QC types are identified as:

TB = Trip Blank

RB = Rinsate Blank (Equipment Blank)

FD = Field Duplicate

AB = Ambient Conditions Blank

WB = Source Water Blank

The sampling time recorded on the chain-of-custody form, labels, and tags for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the routine sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory). Documentation for all other QC types (TB, RB, AB, and WB) will be recorded on the QC Sample Log Sheet (see SOP SA-6.3, Field Documentation).

5.6 <u>EXAMPLES OF FIELD QA/QC SAMPLE NOMENCLATURE</u>

The first duplicate of the day for a filtered groundwater sample collected on June 3, 2000, would be designated as FD06030001-F.

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2003, would be designated as FD11170303.

subject	Number CT-04	Page 7 of 7
SAMPLE NOMENCLATURE	Revision 2	Effective Date 03/09/09
The first trip blank associated with s	amples collected on October	<u>-</u>
The only rinsate blank collected on No	vember 17, 2001, would be de	esignated as RB11170101.
6.0 DEVIATIONS		
Any deviation from this SOP must be a	addressed in detail in the site-s	specific planning documents.



TETRA TECH

STANDARD OPERATING PROCEDURES

Number GH-1.3	Page 1 of 26
Effective Date 01/2012	Revision 2

Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject

SOIL AND ROCK DRILLING METHODS

Approved

J. Zimmerly

TABLE OF CONTENTS

SEC	<u>TION</u>		<u>PAGE</u>
1.0	PURPOSI	E	3
2.0	SCOPE		3
3.0	GLOSSA	RY	3
4.0		SIBILITIES	
5.0		URES	_
5.0			
	5.1	GENERAL	
	5.2 5.2.1	DRILLING METHODSContinuous-Flight Hollow-Stem Auger Drilling	
	5.2.1 5.2.2	Continuous-Flight Solid-Stem Auger Drilling	
	5.2.3	Rotary Drilling	
	5.2.4	Rotosonic Drilling	
	5.2.5	Reverse Circulation Rotary Drilling	
	5.2.6	Drill-through Casing Driver	
	5.2.7	Cable Tool Drilling	11
	5.2.8	Jet Drilling (Washing)	
	5.2.9	Drilling with a Hand Auger	
	5.2.10	Rock Drilling and Coring	
	5.2.11 5.2.12	Drilling & Support Vehicles	
	5.2.12 5.2.13	Equipment SizesEstimated Drilling Progress	
	5.2.13	PREVENTION OF CROSS-CONTAMINATION	
	5.4	CLEANOUT OF CASING PRIOR TO SAMPLING	
	5.5	MATERIALS OF CONSTRUCTION	
	5.6	SUBSURFACE SOIL SAMPLES	
	5.7	ROCK SAMPLING (CORING) (ASTM D2113-83)	19
	5.7.1	Diamond Core Drilling	
	5.7.2	Rock Sample Preparation and Documentation	23
6.0	REFEREN	NCES	24
<u>ATT</u>	<u>ACHMENT</u>		
	A I	DRILLING EQUIPMENT SIZES	25

Subject SOIL AND ROCK	Number GH-1.3	Page 2 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

FIGURE

NUMBER	<u> </u>	<u>PAGE</u>
1	STANDARD SIZES OF CORE BARRELS AND CASING	

Subject	Number	Page
SOIL AND ROCK	GH-1.3	3 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

1.0 PURPOSE

The purpose of this procedure is to describe the methods and equipment necessary to perform soil and rock borings and identify the equipment, sequence of events, and appropriate methods necessary to obtain soil, both surface and subsurface, and rock samples during field sampling activities.

2.0 SCOPE

This guideline addresses most of the accepted and standard drilling techniques, their benefits, and drawbacks. It should be used generally to determine what type of drilling techniques would be most successful depending on site-specific geologic conditions and the type of sampling required.

The sampling methods described within this procedure are applicable to collecting surface and subsurface soil samples, and obtaining rock core samples for lithologic and hydrogeologic evaluation, excavation/foundation design, remedial alternative design and related civil engineering purposes.

3.0 GLOSSARY

<u>Rock Coring</u> - A method in which a continuous solid cylindrical sample of rock or compact rock-like soil is obtained by the use of a double tube core barrel that is equipped with an appropriate diamond-studded drill bit which is advanced with a hydraulic rotary drilling machine.

<u>Wire-Line Coring</u> - As an alternative to conventional coring, this technique is valuable in deep hole drilling, since this method eliminates trips in and out of the hole with the coring equipment. With this technique, the core barrel becomes an integral part of the drill rod string. The drill rod serves as both a coring device and casing.

4.0 RESPONSIBILITIES

<u>Project Manager</u> - In consultation with the project geologist, the Project Manager is responsible for evaluating the drilling requirements for the site and specifying drilling techniques that will be successful given the study objectives and the known or suspected geologic conditions at the site. The Project Manager also determines the disposal methods for products generated by drilling, such as drill cuttings and well development water, as well as any specialized supplies or logistical support required for the drilling operations.

<u>Field Operations Leader (FOL)</u> - The FOL is responsible for the overall supervision and scheduling of drilling activities, and is strongly supported by the project geologist.

<u>Project Geologist</u> - The project geologist is responsible for ensuring that standard and approved drilling procedures are followed. The geologist will generate a detailed boring log for each test hole. This log shall include a description of materials, samples, method of sampling, blow counts, and other pertinent drilling and testing information that may be obtained during drilling (see SOPs SA-6.3 and GH-1.5). Often this position for inspecting the drilling operations may be filled by other geotechnical personnel, such as soils and foundation engineers, civil engineers, etc.

Determination of the exact location for borings is the responsibility of the site geologist. The final location for drilling must be properly documented on the boring log. The general area in which the borings are to be located will be shown on a site map included in the Work Plan and/or Sampling and Analysis Plan.

<u>Drilling Subcontractor</u> - Operates under the supervision of the FOL. Responsible for obtaining all drilling permits and clearances, and supplying all services (including labor), equipment and material required to

Subject	Number	Page
SOIL AND ROCK	GH-1.3	4 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

perform the drilling, testing, and well installation program, as well as maintenance and quality control of such required equipment except as stated in signed and approved subcontracts.

The driller must report any major technical or analytical problems encountered in the field to the FOL within 24 hours of determination, and must provide advance written notification of any changes in field procedures, describing and justifying such changes. No such changes shall be made unless requested and authorized in writing by the FOL (with the concurrence of the Project Manager). Depending on the subcontract, the Project Manager may need to obtain written authorization from appropriate administrative personnel before approving any changes.

The drilling subcontractor is responsible for following decontamination procedures specified in the project plan documents. Upon completion of the work, the driller is responsible for demobilizing all equipment, cleaning up any materials deposited on site during drilling operations, and properly backfilling any open borings.

5.0 PROCEDURES

5.1 General

The purpose of drilling boreholes is:

- To determine the type, thickness, and certain physical and chemical properties of the soil, water and rock strata which underlie the site.
- To install monitoring wells or piezometers.

All drilling and sampling equipment will be cleaned between samples and borings using appropriate decontamination procedures as outlined in SOP SA-7.1. Unless otherwise specified, it is generally advisable to drill borings at "clean" locations first, and at the most contaminated locations last, to reduce the risk of spreading contamination between locations. All borings must be logged by the site geologist as they proceed (see SOPs SA-6.3 and GH-1.5). Situations where logging would not be required would include installation of multiple well points within a small area, or a "second attempt" boring adjacent to a boring that could not be continued through resistant material. In the latter case, the boring log can be resumed 5 feet above the depth at which the initial boring was abandoned, although the site geologist should still confirm that the stratigraphy at the redrilled location conforms essentially with that encountered at the original location. If significant differences are seen, each hole should be logged separately.

5.2 Drilling Methods

The selected drilling methods described below apply to drilling in subsurface materials, including, but not limited to, sand, gravel, clay, silt, cobbles, boulders, rock and man-made fill. Drilling methods should be selected after studying the site geology and terrain, the waste conditions at the site, and reviewing the purpose of drilling and the overall subsurface investigation program proposed for the site. The full range of different drilling methods applicable to the proposed program should be identified with final selection based on relative cost, availability, time constraints, and how well each method meets the sampling and testing requirements of the individual drilling program.

5.2.1 Continuous-Flight Hollow-Stem Auger Drilling

This method of drilling consists of rotating augers with a hollow stem into the ground. Cuttings are brought to the surface by the rotating action of the auger. This method is relatively quick and inexpensive. Advantages of this type of drilling include:

Subject	Number	Page
SOIL AND ROCK	GH-1.3	5 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

- Samples can be obtained without pulling the augers out of the hole. However, this is a poor method for obtaining grab samples from thin, discrete formations because of mixing of soils which occurs as the material is brought to the surface. Sampling of such formations requires the use of split-barrel or thin-wall tube samplers advanced through the hollow core of the auger.
- No drilling fluids are required.
- A well can be installed inside the auger stem and backfilled as the augers are withdrawn.

Disadvantages and limitations of this method of drilling include:

- Augering can only be done in unconsolidated materials.
- The inside diameter of hollow stem augers used for well installation should be at least 4 inches greater than the well casing. Use of such large-diameter hollow-stem augers is more expensive than the use of small-diameter augers in boreholes not used for well installation. Furthermore, the density of unconsolidated materials and depths become more of a limiting factor. More friction is produced with the larger diameter auger and subsequently greater torque is needed to advance the boring.
- The maximum effective depth for drilling is 150 feet or less, depending on site conditions and the size of augers used.
- In augering through clean sand formations below the water table, the sand will tend to flow into the hollow stem when the plug is removed for soil sampling or well installation. If the condition of "running" or "flowing" sands is persistent at a site, an alternative method of drilling is recommended, in particular for wells or boreholes deeper than 25 feet.

Hollow-stem auger drilling is the preferred method of drilling. Most alternative methods require the introduction of water or mud downhole (air rotary is the exception) to maintain the open borehole. With these other methods, great care must be taken to ensure that the method does not interfere with the collection of a representative sample (which may be the prime objective of the borehole construction). With this in mind, the preferred order of choice of drilling method after hollow-stem augering (HSA) is:

- Cable tool
- Casing drive (air)
- Air rotary
- Mud rotary
- Rotosonic
- Drive and wash
- Jetting

However, the use of any method will also depend on efficiency and cost-effectiveness. In many cases, mud rotary is the only feasible alternative to hollow-stem augering. Thus, mud rotary drilling is generally acceptable as a first substitute for HSA.

The procedures for sampling soils through holes drilled by hollow-stem auger shall conform with the applicable ASTM Standards: D1587-83 and D1586-84. The guidelines established in SOP SA-1.3 shall also be followed. The hollow-stem auger may be advanced by any power-operated drilling machine having sufficient torque and ram range to rotate and force the auger to the desired depth. The machine must, however, be equipped with the accessory equipment needed to perform required sampling, or rock coring.

The hollow-stem auger may be used without the plug when boring for geotechnical examination or for well installation. However, when drilling below the water table, specially designed plugs which allow

Subject	Number	Page
SOIL AND ROCK	GH-1.3	6 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

passage of formation water but not solid material shall be used (see Reference 1 of this guideline). This drilling configuration method also prevents blow back and plugging of the auger when the plug is removed for sampling.

Alternately, it may be necessary to keep the hollow stem full of water, at least to the level of the water table, to prevent blowback and plugging of the auger. If water is added to the hole, it must be sampled and analyzed to determine if it is free from contaminants prior to use. In addition, the amount of water introduced, the amount recovered upon attainment of depth, and the amount of water extracted during well development must be carefully logged in order to ensure that a representative sample of the formation water can be obtained. Well development should occur as soon after well completion as practicable (see SOP GH-2.8 for well development procedures). If gravelly or hard material is encountered which prevents advancing the auger to the desired depth, augering should be halted and either driven casing or hydraulic rotary methods should be attempted. If the depth to the bedrock/soil interface and bedrock lithology must be determined, then a 5-foot confirmatory core run should be conducted (see Section 5.2.9).

At the option of the Field Operations Leader (in communication with the Project Manager), when resistant materials prevent the advancement of the auger, a new boring can be attempted. The original boring must be properly backfilled and the new boring started a short distance away at a location determined by the site geologist. If multiple water bearing strata were encountered, the original boring must be grouted. In some formations, it may be prudent to also grout borings which penetrate only the water table aquifer, since loose soil backfill in the boring may still provide a preferred pathway for surface liquids to reach the water table. Backfilling requirements may also be driven by state or local regulations.

5.2.2 Continuous-Flight Solid-Stem Auger Drilling

This drilling method is similar to hollow-stem augering. Practical application of this method is severely restricted compared to use of hollow-stem augers. Split-barrel (split-spoon) sampling cannot be performed without pulling the augers out, which may allow the hole to collapse. The continuous-flight solid-stem auger drilling method is therefore very time consuming and is not cost effective. Also, augers would have to be withdrawn before installing a monitoring well, which again, may allow the hole to collapse. Furthermore, geologic logging by examining the soils brought to the surface is unreliable, and depth to water may be difficult to determine while drilling.

There would be very few situations where use of a solid-stem auger would be preferable to other drilling methods. The only practical applications of this method would be to drill boreholes for well installation where no lithologic information is desired and the soils are such that the borehole can be expected to remain open after the augers are withdrawn. Alternatively, this technique can be used to find depth to bedrock in an area when no other information is required from drilling.

5.2.3 Rotary Drilling

Direct rotary drilling includes air-rotary and fluid-rotary drilling. For air or fluid-rotary drilling, the rotary drill may be advanced to the desired depth by any power-operated drilling machine having sufficient torque and ram range to rotate and force the bit to the desired depth. The drilling machine must, however, be equipped with any accessory equipment needed to perform required sampling, or coring. Prior to sampling, any settled drill cuttings in the borehole must be removed.

Air-rotary drilling is a method of drilling where the drill rig simultaneously turns and exerts a downward pressure on the drilling rods and bit while circulating compressed air down the inside of the drill rods, around the bit, and out the annulus of the borehole. Air circulation serves to both cool the bit and remove the cuttings from the borehole. Advantages of this method include:

Subject SOIL AND ROCK	Number GH-1.3	Page 7 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

- The drilling rate is high (even in rock).
- The cost per foot of drilling is relatively low.
- Air-rotary rigs are common in most areas.
- No drilling fluid is required (except when water is injected to keep down dust).
- The borehole diameter is large, to allow room for proper well installation procedures.

Disadvantages to using this method include:

- Formations must be logged from the cuttings that are blown to the surface and thus the depths of materials logged are approximate.
- Air blown into the formation during drilling may "bind" the formation and impede well development and natural groundwater flow.
- In-situ samples cannot be taken, unless the hole is cased.
- Casing must generally be used in unconsolidated materials.
- Air-rotary drill rigs are large and heavy.
- Large amounts of Investigation Derived Waste (IDW) may be generated which may require containerization, sampling, and off-site disposal.

A variation of the typical air-rotary drill bit is a down hole hammer which hammers the drill bit down as it drills. This makes drilling in hard rock faster. Air-rotary drills can also be adapted to use for rock coring although they are generally slower than other types of core drills. A major application of the air-rotary drilling method would be to drill holes in rock for well installation.

Fluid-Rotary drilling operates in a similar manner to air-rotary drilling except that a drilling fluid ("mud") or clean water is used in place of air to cool the drill bit and remove cuttings. There are a variety of fluids that can be used with this drilling method, including bentonite slurry and synthetic slurries. If a drilling fluid other than water/cuttings is used, it must be a natural clay (i.e., bentonite) and a "background" sample of the fluid should be taken for analysis of possible organic or inorganic contaminants.

Advantages to the fluid-rotary drilling method include:

- The ability to drill in many types of formations.
- Relatively quick and inexpensive.
- Split-barrel (split-spoon) or thin-wall (Shelby) tube samples can be obtained without removing drill rods if the appropriate size drill rods and bits (i.e., fish-tail or drag bit) are used.
- In some borings temporary casing may not be needed as the drilling fluids may keep the borehole open.
- Drill rigs are readily available in most areas.

Disadvantages to this method include:

 Formation logging is not as accurate as with hollow-stem auger method if split-barrel (split-spoon) samples are not taken (i.e., the depths of materials logged from cuttings delivered to the surface are approximate).

Subject Subject	Number	Page
SOIL AND ROCK	GH-1.3	8 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

- Drilling fluids reduce permeability of the formation adjacent to the boring to some degree, and require more extensive well development than "dry" techniques (augering, air-rotary).
- No information on depth to water is obtainable while drilling.
- Fluids are needed for drilling, and there is some question about the effects of the drilling fluids on subsequent water samples obtained. For this reason as well, extensive well development may be required.
- In very porous materials (i.e., rubble fill, boulders, coarse gravel) drilling fluids may be continuously lost into the formation. This requires either constant replenishment of the drilling fluid, or the use of casing through this formation.
- Drill rigs are large and heavy, and must be supported with supplied water.
- Groundwater samples can be potentially diluted with drilling fluid.

The procedures for performing direct rotary soil investigations and sampling shall conform with the applicable ASTM standards: D2113-83, D1587-83, and D1586-84.

Soil samples shall be taken as specified by project plan documents, or more frequently, if requested by the project geologist. Any required sampling shall be performed by rotation, pressing, or driving in accordance with the standard or approved method governing use of the particular sampling tool.

When field conditions prevent the advancement of the hole to the desired depth, a new boring may be drilled at the request of the Field Operations Leader. The original boring shall be backfilled using methods and materials appropriate for the given site and a new boring started a short distance away at a location determined by the project geologist.

5.2.4 Rotosonic Drilling

The Rotosonic drilling method employs a high frequency vibrational and low speed rotational motion coupled with down pressure to advance the cutting edge of a drill string. This produces a uniform borehole while providing a continuous, undisturbed core sample of both unconsolidated and most bedrock formations. Rotosonic drilling advances a 4-inch diameter to 12-inch diameter core barrel for sampling and can advance up to a 12-inch diameter outer casing for the construction of standard and telescoped monitoring wells. During drilling, the core barrel is advanced ahead of the outer barrel in increments as determined by the site geologist and depending upon type of material, degree of subsurface contamination and sampling objectives.

The outer casing can be advanced at the same time as the inner drill string and core barrel, or advanced down over the inner drill rods and core barrel, or after the core barrel has moved ahead to collect the undisturbed sample and has been pulled out of the borehole. The outer casing can be advanced dry in most cases, or can be advanced with water or air depending upon the formations being drilled, the depth and diameter of the hole, or requirements of the project.

Advantages of this method include:

- Sampling and well installation are faster as compared to other drilling methods.
- Continuous sampling, with larger sample volume as compared to split-spoon sampling.

Subject	Number	Page
SOIL AND ROCK	GH-1.3	9 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

- The ability to drill through difficult formations such as cobbles or boulders, hard till and bedrock.
- Reduction of IDW by an average of 70 to 80 percent.
- Well installations are quick and controlled by elimination of potential bridging of annular materials during well installation, due to the ability to vibrate the outer casing during removal.

Disadvantages include:

- The cost for Rotosonic drilling as compared to other methods are generally higher. However, the net result can be a significant savings considering reduced IDW and shortened project duration.
- Rotosonic drill rigs are large and need ample room to drill, however, Rotosonic units can be placed on the ground or placed on an ATV.
- There are a limited number of Rotosonic drilling contractors at the present time.

5.2.5 Reverse Circulation Rotary Drilling

The common reverse-circulation rig is a water or mud-rotary rig with a large-diameter drill pipe which circulates the drilling water down the annulus and up the inside of the drill pipe (reverse flow direction from direct mud-rotary). This type of rig is used for the construction of large-capacity production water wells and is not suited for small, water quality sampling wells because of the use of drilling muds and the large-diameter hole which is created. A few special reverse-circulation rotary rigs are made with double-wall drill pipe. The drilling water or air is circulated down the annulus between the drill pipes and up inside the inner pipe.

Advantages of the latter method include:

- The formation water is not contaminated by the drilling water.
- Formation samples can be obtained, from known depths.
- When drilling with air, immediate information is available regarding the water-bearing properties of formations penetrated.
- Collapsing of the hole in unconsolidated formations is not as great a problem as when drilling with the normal air-rotary rig.

Disadvantages include:

- Double-wall, reverse-circulation drill rigs are rare and expensive to operate.
- Placing cement grout around the outside of the well casing above a well screen often is difficult, especially when the screen and casing are placed down through the inner drill pipe before the drill pipe is pulled out.

5.2.6 Drill-through Casing Driver

The driven-casing method consists of alternately driving casing (fitted with a sharp, hardened casing shoe) into the ground using a hammer lifted and dropped by the drill rig (or an air-hammer) and cleaning out the casing using a rotary chopping bit and air or water to flush out the materials. The casing is driven down in stages (usually 5 feet per stage); a continuous record is kept of the blows per foot in driving the

Subject	Number	Page
SOIL AND ROCK DRILLING METHODS	GH-1.3	10 of 26
	Revision	Effective Date
	2	01/2012

casing (see SOP GH-1.5). The casing is normally advanced by a 300-pound hammer falling freely through a height of 30 inches. Simultaneous washing and driving of the casing is not recommended. If this procedure is used, the elevations within which wash water is used and in which the casing is driven must be clearly recorded.

The driven casing method is used in unconsolidated formations only. When the boring is to be used for later well installation, the driven casing used should be at least 4 inches larger in diameter than the well casing to be installed. Advantages to this method of drilling include:

- Split-barrel (split-spoon) sampling can be conducted while drilling.
- Well installation is easily accomplished.
- Drill rigs used are relatively small and mobile.
- The use of casing minimizes flow into the hole from upper water-bearing layers; therefore, multiple
 aquifers can be penetrated and sampled for rough field determinations of some water quality
 parameters.

Some of the disadvantages include:

- This method can only be used in unconsolidated formations.
- The method is slower than other methods (average drilling progress is 30 to 50 feet per day).
- Maximum depth of the borehole varies with the size of the drill rig and casing diameter used, and the nature of the formations drilled.
- The cost per hour or per foot of drilling may be substantially higher than other drilling methods.
- It is difficult and time consuming to pull back the casing if it has been driven very deep (deeper than 50 feet in many formations).

5.2.7 Cable Tool Drilling

A cable tool rig uses a heavy, solid-steel, chisel-type drill bit ("tool") suspended on a steel cable, which when raised and dropped, chisels or pounds a hole through the soils and rock. Drilling progress may be expedited by the use of "slip-jars" which serve as a cable-activated down hole percussion device to hammer the bit ahead.

When drilling through the unsaturated zone, some water must be added to the hole. The cuttings are suspended in the water and then bailed out periodically. Below the water table, after sufficient ground water enters the borehole to replace the water removed by bailing, no further water needs to be added. When soft caving formations are encountered, it is usually necessary to drive casing as the hole is advanced to prevent collapse of the hole. Often the drilling can be only a few feet below the bottom of the casing. Because the drill bit is lowered through the casing, the hole created by the bit is smaller than the casing. Therefore, the casing (with a sharp, hardened casing shoe on the bottom) must be driven into the hole (see Section 5.2.5 of this guideline).

Advantages of the cable-tool method include the following:

Subject	Number	Page
SOIL AND ROCK DRILLING METHODS	GH-1.3	11 of 26
	Revision	Effective Date
	2	01/2012

- Information regarding water-bearing zones is readily available during the drilling. Even relative permeabilities and rough water quality data from different zones penetrated can be obtained by skilled operators.
- The cable-tool rig can operate satisfactorily in all formations, but is best suited for caving, boulder, cobble or coarse gravel type formations (e.g., glacial till) or formations with large cavities above the water table (such as limestones).
- When casing is used, the casing seals formation water out of the hole, preventing down hole contamination and allowing sampling of deeper aquifers for field-measurable water quality parameters.
- Split-barrel (split-spoon) or thin-wall (Shelby) tube samples can be collected through the casing.

Disadvantages include:

- Drilling is slow compared with rotary rigs.
- The necessity of driving the casing in unconsolidated formations requires that the casing be pulled back if exposure of selected water-bearing zones is desired. This process complicates the well completion process and often increases costs. There is also a chance that the casing may become stuck in the hole.
- The relatively large diameters required (minimum of 4-inch casing) plus the cost of steel casing result
 in higher costs compared to rotary drilling methods where casing is not required (e.g., such use of a
 hollow-stem auger).
- Cable-tool rigs have largely been replaced by rotary rigs. In some parts of the U.S., availability may
 be difficult.

5.2.8 Jet Drilling (Washing)

Jet drilling, which should be used only for piezometer or vadose zone sampler installation, consists of pumping water or drilling mud down through a small diameter (1/2- to 2-inch) standard pipe (steel or PVC). The pipe may be fitted with a chisel bit or a special jetting screen. Formation materials dislodged by the bit and jetting action of the water are brought to the surface through the annulus around the pipe. As the pipe is jetted deeper, additional lengths of pipe may be added at the surface.

Jet percussion is a variation of the jetting method, in which the casing is driven with a drive weight. Normally, this method is used to place 2-inch-diameter casing in shallow, unconsolidated sand formations, but this method has also been used to install 3- to 4-inch-diameter casings to a depth of 200 feet.

Jetting is acceptable in very soft formations, usually for shallow sampling, and when introduction of drilling water to the formation is acceptable. Such conditions would occur during rough stratigraphic investigation or installation of piezometers for water level measurement. Advantages of this method include:

- Jetting is fast and inexpensive.
- Because of the small amount of equipment required, jetting can be accomplished in locations where
 access by a normal drilling rig would be very difficult. For example, it would be possible to jet down a
 well point in the center of a lagoon at a fraction of the cost of using a drill rig.

Subject SOIL AND ROCK DRILLING METHODS	Number GH-1.3	Page 12 of 26
	Revision 2	Effective Date 01/2012

 Jetting numerous well points just into a shallow water table is an inexpensive method for determining the water table contours, hence flow direction.

Disadvantages include the following:

- A large amount of foreign water or drilling mud is introduced above and into the formation to be sampled.
- Jetting is usually done in very soft formations which are subject to caving. Because of this caving, it is often not possible to place a grout seal above the screen to assure that water in the well is only from the screened interval.
- The diameter of the casing is usually limited to 2 inches.
- Jetting is only possible in very soft formations that do not contain boulders or coarse gravel, and the depth limitation is shallow (about 30 feet without jet percussion equipment).
- Large quantities of water are often needed.

5.2.9 Drilling with a Hand Auger

This method is applicable wherever the formation, total depth of sampling, and the site and groundwater conditions are such as to allow hand auger drilling. Hand augering can also be considered at locations where drill rig access is not possible. All hand auger borings will be performed according to ASTM D1452-80.

Samples should be taken continuously unless otherwise specified by the project plan documents. Any required sampling is performed by rotation, pressing, or driving in accordance with the standard or approved method governing use of the particular sampling tool. Typical equipment used for sampling and advancing shallow "hand auger" holes are Iwan samplers (which are rotated) or post hole diggers (which are operated like tongs). These techniques are slow but effective where larger pieces of equipment do not have access, and where very shallow holes are desired (less than 15 feet). Surficial soils must be composed of relatively soft and non-cemented formations to allow penetration by the auger.

5.2.10 Rock Drilling and Coring

When soil borings cannot be continued using augers or rotary methods due to the hardness of the soil or when rock or large boulders are encountered, drilling and sampling can be performed using a diamond bit corer in accordance with ASTM D2113.

Drilling is done by rotating and applying downward pressure to the drill rods and drill bit. The drill bit is a circular, hollow, diamond-studded bit attached to the outer core barrel in a double-tube core barrel. The use of single-tube core barrels is not recommended, as the rotation of the barrel erodes the sample and limits its use for detailed geological evaluation. Water or air is circulated down through the drill rods and annular space between the core barrel tubes to cool the bit and remove the cuttings. The bit cuts a core out of the rock which rises into an inner barrel mounted inside the outer barrel. The inner core barrel and rock core are removed by lowering a wire line with a coupling into the drill rods, latching onto the inner barrel and withdrawing the inner barrel. A less efficient variation of this method utilizes a core barrel that cannot be removed without pulling all of the drill rods. This variation is practical only if less than 50 feet of core is required.

Core borings are made through the casing used for the soil borings. The casing must be driven and sealed into the rock formation to prevent seepage from the overburden into the hole to be cored (see

Subject SOIL AND ROCK DRILLING METHODS	Number GH-1.3	Page 13 of 26
	Revision 2	Effective Date 01/2012

Section 5.3 of this guideline). A double-tube core barrel with a diamond bit and reaming shell or equivalent should be used to recover rock cores of a size specified in the project plans. The most common core barrel diameters are listed in Attachment A.

Soft or decomposed rock should be sampled with a driven split-barrel whenever possible or cored with a Denison or Pitcher sampler.

When coring rock, including shale and claystone, the speed of the drill and the drilling pressure, amount and pressure of water, and length of run can be varied to give the maximum recovery from the rock being drilled. Should any rock formation be so soft or broken that the pieces continually fall into the hole causing unsatisfactory coring, the hole should be reamed and a flush-joint casing installed to a point below the broken formation. The size of the flush-joint casing must permit securing the core size specified. When soft or broken rock is anticipated, the length of core runs should be reduced to less than 5 feet to avoid core loss and minimize core disturbance.

Advantages of core drilling include:

- Undisturbed rock cores can be recovered for examination and/or testing.
- In formations in which the cored hole will remain open without casing, water from the rock fractures may be recovered from the well without the installation of a well screen and gravel pack.
- Formation logging is extremely accurate.
- Drill rigs are relatively small and mobile.

Disadvantages include:

- Water or air is needed for drilling.
- Coring is slower than rotary drilling (and more expensive).
- Depth to water cannot accurately be determined if water is used for drilling.
- The size of the borehole is limited.

This drilling method is useful if accurate determinations of rock lithology are desired or if open wells are to be installed into bedrock. To install larger diameter wells in coreholes, the hole must be reamed out to the proper size after boring, using air or mud rotary drilling methods.

5.2.11 Drilling & Support Vehicles

In addition to the drilling method required to accomplish the objectives of the field program, the type of vehicle carrying the drill rig and/or support equipment and its suitability for the site terrain, will often be an additional deciding factor in planning the drilling program. The types of vehicles available are extensive, and depend upon the particular drilling subcontractor's fleet. Most large drilling subcontractors will have a wide variety of vehicle and drill types suited for most drilling assignments in their particular region, while smaller drilling subcontractors will usually have a fleet of much more limited diversity. The weight, size, and means of locomotion (tires, tracks, etc.) of the drill rig must be selected to be compatible with the site terrain to assure adequate mobility between borehole locations. Such considerations also apply to necessary support vehicles used to transport water and/or drilling materials to the drill rigs at the borehole locations. When the drill rigs or support vehicles do not have adequate mobility to easily traverse the site, provisions must be made for assisting equipment, such as bulldozers, winches, timber planking, etc., to maintain adequate progress during the drilling program.

Some of the typical vehicles which are usually available for drill rigs and support equipment are:

Subject	Number	Page
SOIL AND ROCK DRILLING METHODS	GH-1.3	14 of 26
	Revision	Effective Date
	2	01/2012

- Totally portable drilling/sampling equipment, where all necessary components (tripods, samplers, hammers, catheads, etc.) may be hand carried to the borehole site. Drilling/sampling methods used with such equipment include:
 - Hand augers and lightweight motorized augers.
 - Retractable plug samplers--driven by hand (hammer).
 - Motorized cathead a lightweight aluminum tripod with a small gas-engine cathead mounted on one leg, used to install small-diameter cased borings. This rig is sometimes called a "monkey on a stick."
- Skid-mounted drilling equipment containing a rotary drill or engine-driven cathead (to lift hammers and drill string), a pump, and a dismounted tripod. The skid is pushed, dragged, or winched (using the cathead drum) between boring locations.
- Small truck-mounted drilling equipment using a Jeep, stake body or other light truck (4 to 6 wheels), upon which are mounted the drill and/or a cathead, a pump, and a tripod or small drilling derrick. On some rigs, the drill and/or a cathead are driven by a power take-off from the truck, instead of by a separate engine.
- Track-mounted drilling equipment is similar to truck-mounted rigs, except that the vehicle used has
 wide bulldozer tracks for traversing soft ground. Sometimes a continuous-track "all terrain vehicle" is
 also modified for this purpose. Some types of tracked drill rigs are called "bombardier" or "weasel"
 rigs.
- Heavy truck-mounted drilling equipment is mounted on tandem or dual tandem trucks to transport the
 drill, derrick, winches, and pumps or compressors. The drill may be provided with a separate engine
 or may use a power take-off from the truck engine. Large augers, hydraulic rotary and reverse
 circulation rotary drilling equipment are usually mounted on such heavy duty trucks. For soft-ground
 sites, the drilling equipment is sometimes mounted on vehicles having low pressure, very wide
 diameter tires and capable of floating; these vehicles are called "swamp buggy" rigs.
- Marine drilling equipment is mounted on various floating equipment for drilling borings in lakes, estuaries and other bodies of water. The floating equipment varies, and is often manufactured or customized by the drilling subcontractor to suit specific drilling requirements. Typically, the range of flotation vehicles include:
 - Barrel-float rigs a drill rig mounted on a timber platform buoyed by empty 55-gallon drums or similar flotation units.
 - Barge-mounted drill rigs.
- Jack-up platforms drilling equipment mounted on a floating platform having retractable legs to support the unit on the sea or lake bed when the platform is jacked up out of the water.
- Drill ships for deep ocean drilling.

In addition to the mobility for the drilling equipment, similar consideration must be given for equipment to support the drilling operations. Such vehicles or floating equipment are needed to transport drill water, drilling supplies and equipment, samples, drilling personnel, etc. to and/or from various boring locations.

Subject	Number	Page
SOIL AND ROCK	GH-1.3	15 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

5.2.12 Equipment Sizes

In planning subsurface exploration programs, care must be taken in specifying the various drilling components, so that they will fit properly in the boring or well.

For drilling open boreholes using rotary drilling equipment, tri-cone drill bits are employed with air, water or drilling mud to remove cuttings and cool the bit. Tri-cone bits are slightly smaller than the holes they drill (i.e., 5-7/8-inch or 7-7/8-inch bits will nominally drill 6-inch and 8-inch holes, respectively).

For obtaining split-barrel samples of a formation, samplers are commonly manufactured in sizes ranging from 2 inches to 3-1/2 inches in outside diameter. However, the most commonly used size is the 2-inch O.D., 1-3/8-inch I.D. split-barrel sampler. When this sampler is used and driven by a 140-pound (\forall 2-pound) hammer dropping 30 inches (\forall 1 inch), the procedure is called a Standard Penetration Test, and the blows per foot required to advance the sampler into the formation can be correlated to the formation's density or strength.

In planning the drilling of boreholes using hollow-stem augers or casing, in which thin-wall tube samples or diamond core drilling will be performed, refer to the various sizes and clearances provided in Attachment A of this guideline. Sizes selected must be stated in the project plan documents.

5.2.13 Estimated Drilling Progress

To estimate the anticipated rates of drilling progress for a site, the following must be considered:

- The speed of the drilling method employed.
- Applicable site conditions (e.g., terrain, mobility between borings, difficult drilling conditions in bouldery soils, rubble fill or broken rock, etc.).
- Project-imposed restrictions (e.g., drilling while wearing personal protective equipment, decontamination of drilling equipment, etc.).

Based on recent experience in drilling average soil conditions (no boulders) and taking samples at 5-foot intervals, for moderate depth (30 feet to 50 feet) boreholes (not including installation or development of wells), the following daily rates of total drilling progress may be anticipated for the following drilling methods:

Drilling Method	Average Daily Progress (linear feet)
Hollow-stem augers	75'
Solid-stem augers	50'
Mud-Rotary Drilling	100' (cuttings samples)
Rotosonic Drilling	100'-160' (continuous core)
Reverse-Circulation Rotary	100' (cuttings samples)
Skid-Rig with driven casing	30'
Rotary with driven casing	50'
Cable Tool	30'
Hand Auger	Varies
Continuous Rock Coring	50'

Subject SOIL AND ROCK DRILLING METHODS	Number GH-1.3	Page 16 of 26
	Revision 2	Effective Date 01/2012

5.3 <u>Prevention of Cross-Contamination</u>

A telescoping or multiple casing technique minimizes the potential for the migration of contaminated groundwater to lower strata below a confining layer. The telescoping technique consists of drilling to a confining layer utilizing a spun casing method with a diamond cutting or augering shoe (a method similar to the rock coring method described in Section 5.2.10, except that larger casing is used) or by using a driven-casing method (see Section 5.2.6 of this guideline) and installing a specified diameter steel well casing. The operation consists of three separate steps. Initially, a drilling casing (usually of 8-inch diameter) is installed followed by installation of the well casing (6-inch-diameter is common for 2-inch wells). This well casing is driven into the confining layer to ensure a tight seal at the bottom of the hole. The well casing is sealed at the bottom with a bentonite-cement slurry. The remaining depth of the boring is drilled utilizing a narrower diameter spun or driven casing technique within the outer well casing. A smaller diameter well casing with an appropriate length of slotted screen on the lower end, is installed to the surface.

Clean sand is placed in the annulus around and to a point of about 2 feet above the screen prior to withdrawal of the drilling casing. The annular space above the screen and to a point 2 feet above the bottom of the outer well casing is sealed with a tremied cement-bentonite slurry which is pressure-grouted or displacement-grouted into the hole. The remaining casing annulus is backfilled with clean material and grouted at the surface, or it is grouted all the way to the surface.

5.4 Cleanout of Casing Prior to Sampling

The boring hole must be completely cleaned of disturbed soil, segregated coarse material and clay adhering to the inside walls of the casing. The cleaning must extend to the bottom edge of the casing and, if possible, a short distance further (1 or 2 inches) to bypass disturbed soil resulting from the advancement of the casing. Loss of wash water during cleaning should be recorded.

For disturbed samples both above and below the water table and where introduction of relatively large volumes of wash water is permissible, the cleaning operation is usually performed by washing the material out of the casing with water; however, the cleaning should never be accomplished with a strong, downward-directed jet which will disturb the underlying soil. When clean out has reached the bottom of the casing or slightly below (as specified above), the string of tools should be lifted one foot off the bottom with the water still flowing, until the wash water coming out of the casing is clear of granular soil particles. In formations where the cuttings contain gravel and other larger particles, it is often useful to repeatedly raise and lower the drill rods and wash bit while washing out the hole, to surge these large particles upward out of the hole. As a time saver, the drilling contractor may be permitted to use a split-barrel (split-spoon) sampler with the ball check valve removed as the clean-out tool, provided the material below the spoon is not disturbed and the shoe of the spoon is not damaged. However, because the ball check valve has been removed, in some formations it may be necessary to install a flap valve or spring sample retainer in the split-spoon bit, to prevent the sample from falling out as the sampler is withdrawn from the hole. The use of jet-type chopping bits is discouraged except where large boulders and cobbles or hardcemented soils are encountered. If water markedly softens the soils above the water table, clean out should be performed dry with an auger.

For undisturbed samples below the water table, or where wash water must be minimized, clean out is usually accomplished with an appropriate diameter clean out auger. This auger has cutting blades at the bottom to carry loose material up into the auger, and up-turned water jets just above the cutting blades to carry the removed soil to the surface. In this manner, there is a minimum of disturbance at the top of the material to be sampled. If any gravel material washes down into the casing and cannot be removed by the clean out auger, a split-barrel sample can be taken to remove it; bailers and sandpumps should not

Subject	Number	Page
SOIL AND ROCK	GH-1.3	17 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

be used. For undisturbed samples above the groundwater table, all operations must be performed in a dry manner.

If all of the cuttings created by drilling through the overlying formations are not cleaned from the borehole prior to sampling, some of the problems which may be encountered during sampling include:

- When sampling is attempted through the cuttings remaining in the borehole, all or part of the sampler may become filled with the cuttings. This limits the amount of sample from the underlying formation which can enter and be retained in the sampler, and also raises questions as to the validity of the sample.
- If the cuttings remaining in the borehole contain coarse gravel and/or other large particles, these may block the bit of the sampler and prevent any materials from the underlying formation from entering the sampler when the sampler is advanced.
- In cased borings, should sampling be attempted through cuttings which remain in the lower portion of the casing, these cuttings could cause the sampler to become bound into the casing, such that it becomes very difficult to either advance or retract the sampler.
- When sampler blow counts are used to estimate the density or strength of the formation being sampled, the presence of cuttings in the borehole will usually give erroneously high sample blow counts.

To confirm that all cuttings have been removed from the borehole prior to attempting sampling, it is important that the site geologist measure the "stickup" of the drill string. This is accomplished by measuring the assembled length of all drill rods and bits or samplers (the drill string) as they are lowered to the bottom of the hole, below some convenient reference point of the drill string, then measuring the height of this reference point above the ground surface. The difference of these measurements is the depth of the drill string (lower end of the bit or sampler) below the ground surface, which must then be compared with the depth of sampling required (installed depth of casing or depth of borehole drilled). If the length of drill string below grade is more than the drilled or casing depth, the borehole has been cleaned too deeply, and this deeper depth of sampling must be recorded on the log. If the length of drill string below grade is less than the drilled or casing depth, the difference represents the thickness of cuttings which remain in the borehole. In most cases, an inch or two of cuttings may be left in the borehole with little or no problem. However, if more than a few inches of cuttings are encountered, the borehole must be recleaned prior to attempting sampling.

5.5 Materials of Construction

The effects of monitoring well construction materials on specific chemical analytical parameters are described and/or referenced in SOP GH-2.8. However, there are several materials used during drilling, particularly drilling fluids and lubricants, which must be used with care to avoid compromising the representativeness of soil and ground water samples.

The use of synthetic or organic polymer slurries is not permitted at any location where soil samples for chemical analysis are to be collected. These slurry materials could be used for installation of long-term monitoring wells, but the early time data in time series collection of ground water data may then be suspect. If synthetic or organic polymer muds are proposed for use at a given site, a complete written justification including methods and procedures for their use must be provided by the site geologist and approved by the Project Manager. The specific slurry composition and the concentration of suspected contaminants for each site must be known.

Subject	Number	Page
SOIL AND ROCK	GH-1.3	18 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

For many drilling operations, potable water is an adequate lubricant for drill stem and drilling tool connections. However, there are instances, such as drilling in tight clayey formations or in loose gravels, when threaded couplings must be lubricated to avoid binding. In these instances, to be determined in the field by the judgment of the site geologist and noted in the site logbook, and only after approval by the Project Manager, a vegetable oil or silicone-based lubricant should be used. Petroleum based greases, etc. will not be permitted. Samples of lubricants used must be provided and analyzed for chemical parameters appropriate to the given site.

5.6 <u>Subsurface Soil Samples</u>

Subsurface soil samples are used to characterize subsurface stratigraphy. This characterization can indicate the potential for migration of chemical contaminants in the subsurface. In addition, definition of the actual migration of contaminants can be obtained through chemical analysis of the soil samples. Where the remedial activities may include in-situ treatment or excavation and removal of the contaminated soil, the depth and areal extent of contamination must be known as accurately as possible.

Engineering and physical properties of soil may also be of interest should site construction activities be planned. Soil types, grain size distribution, shear strength, compressibility, permeability, plasticity, unit weight, and moisture content are some of the physical characteristics that may be determined for soil samples.

Penetration tests are also described in this procedure. The tests can be used to estimate various physical and engineering parameters such as relative density, unconfined compressive strength, and consolidation characteristics of soils.

Surface protocols for various soil sampling techniques are discussed in SOP SA-1.3. Continuous-core soil sampling and rock coring are discussed below. The procedures described here are representative of a larger number of possible drilling and sampling techniques. The choice of techniques is based on a large number of variables such as cost, local geology, etc. The final choice of methods must be made with the assistance of drilling subcontractors familiar with the local geologic conditions. Alternative techniques must be based upon the underlying principles of quality assurance implicit in the following procedures.

The CME continuous sample tube system provides a method of sampling soil continuously during hollow-stem augering. The 5-foot sample barrel fits within the lead auger of a hollow-auger column. The sampling system can be used with a wide range of I.D. hollow-stem augers (from 3-1/4-inch to 8-1/4-inch I.D.). This method has been used to sample many different materials such as glacial drift, hard clays and shales, mine tailings, etc. This method is particularly used when SPT samples are not required and a large volume of material is needed. Also, this method is useful when a visual description of the subsurface lithology is required. Rotosonic drilling methods also provide a continuous soil sample.

5.7 Rock Sampling (Coring) (ASTM D2113-83)

Rock coring enables a detailed assessment of borehole conditions to be made, showing precisely all lithologic changes and characteristics. Because coring is an expensive drilling method, it is commonly used for shallow studies of 500 feet or less, or for specific intervals in the drill hole that require detailed logging and/or analyzing. Rock coring can, however, proceed for thousands of feet continuously, depending on the size of the drill rig, and yields better quality data than air-rotary drilling, although at a substantially reduced drilling rate. Rate of drilling varies widely, depending on the characteristics of lithologies encountered, drilling methods, depth of drilling, and condition of drilling equipment. Average output in a 10-hour day ranges from 40 to over 200 feet. Down hole geophysical logging or television camera monitoring is sometimes used to complement the data generated by coring.

Subject	Number	Page
SOIL AND ROCK DRILLING METHODS	GH-1.3	19 of 26
	Revision	Effective Date
	2	01/2012

Borehole diameter can be drilled to various sizes, depending on the information needed. Standard sizes of core barrels (showing core diameter) and casing are shown in Figure 1.

Core drilling is used when formations are too hard to be sampled by soil sampling methods and a continuous solid sample is desired. Usually, soil samples are used for overburden, and coring begins in sound bedrock. Casing is set into bedrock before coring begins to prevent loose material from entering the borehole, to prevent loss of drilling fluid, and to prevent cross-contamination of aquifers.

Drilling through bedrock is initiated by using a diamond-tipped core bit threaded to a drill rod (outer core barrel) with a rate of drilling determined by the downward pressure, rotation speed of drill rods, drilling fluid pressure in the borehole, and the characteristics of the rock (mineralogy, cementation, weathering).

Subject SOIL AND ROCK	Number GH-1.3	Page 20 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

FIGURE 1
STANDARD SIZES OF CORE BARRELS AND CASING

Coring Bit Size	Nominal*		Set	Size*	
	O.D.	I.D.	O.D.	I.D.	
RWT	1 5/32	3/4	1.160	0.735	
EWT	1 1/2	29/32	1.470	0.905	
EX, EXL, EWG, EWM	1 1/2	13/16	1.470	0.845	
AWT	1 7/8	1 9/32	1.875	1.281	
AX, AXL, AWG, AWM	1 7/8	1 3/16	1.875	1.185	
BWT	2 3/8	1 3/4	2.345	1.750	
BX, BXL, BWG, BWM	2 3/8	1 5/8	2.345	1.655	
NWT	3	2 5/16	2.965	2.313	
NX, NXL, NWG, NWM	3	2 1/8	2.965	2.155	
HWT	3 29/32	3 3/16	3.889	3.187	
HWG	3 29/32	3	3.889	3.000	
2 3/4 x 3 7/8	3 7/8	2 3/4	3.840	2.690	
4 x 5 1/2	5 1/2	4	5.435	3.970	
6 x 7 3/4	7 3/4	6	7.655	5.970	
AX Wire line/	1 7/8	1	1.875	1.000	
BX Wire line/	2 3/8	1 7/16	2.345	1.437	
NX Wire line/	3	1 15/16	2.965	1.937	

^{*} All dimensions are in inches; to convert to millimeters, multiply by 25.4.

__|__/ Wire line dimensions and designations may vary according to manufacturer.

Subject SOIL AND ROCK	Number GH-1.3	Page 21 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

FIGURE 1 STANDARD SIZES OF CORE BARRELS AND CASING PAGE TWO

Size Des	ignations			sing pling					nate Core neter		
Casing; Casing coupling; Casing bits; Core barrel bits	Rod; rod couplings	Casing O.D., Inches	O.D., Inches	I.D., Inches	Casing bit O.D., Inches	Core barrel bit O.D., Inches*	Drill rod O.D., Inches	Normal, Inches	Thinwall, Inches		
RX	RW	1.437	1.437	1.188	1.485	1.160	1.094		0.735		
EX	E	1.812	1.812	1.500	1.875	1.470	1.313	0.845	0.905		
AX	Α	2.250	2.250	1.906	2.345	1.875	1.625	1.185	1.281		
ВХ	В	2.875	2.875	2.375	2.965	2.345	1.906	1.655	1.750		
NX	N	3.500	3.500	3.000	3.615	2.965	2.375	2.155	2.313		
HX	HW	4.500	4.500	3.938	4.625	3.890	3.500	3.000	3.187		
RW	RW	1.437	ish Joint			1.485	1.160	1.094		0.735	
EW	EW	1.812			1.875	1.470	1.375	0.845	0.905		
AW	AW	2.250		Flush Joint		2.345	1.875	1.750	1.185	1.281	
BW	BW	2.875			Ħ	рu	2.965	2.345	2.125	1.655	1.750
NW	NW	3.500			No Coupling	3.615	2.965	2.625	2.155	2.313	
HW	HW	4.500			Š	4.625	3.890	3.500	3.000	3.187	
PW		5.500	표	2	5.650						
SW		6.625			6.790						
UW		7.625			7.800						
ZW		8.625			8.810						
	AX _\					1.875	1.750	1.000			
	BX _\					2.345	2.250	1.437			
	NX _\					2.965	2.813	1.937			

^{*} All dimensions are in inches; to convert to millimeters, multiply by 25.4.

____/ Wire line dimensions and designations may vary according to manufacturer.

NOMINAL DIMENSIONS FOR DRILL CASINGS AND ACCESSORIES. (DIAMOND CORE DRILL MANUFACTURERS ASSOCIATION). 288-D-2889

Subject	Number	Page
SOIL AND ROCK	GH-1.3	22 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

5.7.1 Diamond Core Drilling

A penetration of typically less than 6 inches per 50 blows using a 140-lb. hammer dropping 30 inches with a 2-inch split-barrel sampler shall be considered an indication that soil sampling methods may not be applicable and that coring may be necessary to obtain samples.

When formations are encountered that are too hard to be sampled by soil sampling methods, the following diamond core drilling procedure may be used:

- Firmly seat a casing into the bedrock or the hard material to prevent loose materials from entering the
 hole and to prevent the loss of drilling fluid return. Level the surface of the rock or hard material when
 necessary by the use of a fishtail or other bits. If the drill hole can be retained open without the
 casing and if cross-contamination of aquifers in the unconsolidated materials is unlikely, leveling may
 be omitted.
- Begin the core drilling using a double-tube swivel-core barrel of the desired size. After drilling no more than 10 feet (3 m), remove the core barrel from the hole and take out the core. If the core blocks the flow of the drilling fluid during drilling, remove the core barrel immediately. In soft materials, a large starting size may be specified for the coring tools; where local experience indicates satisfactory core recovery or where hard, sound materials are anticipated, a smaller size or the single-tube type may be specified and longer runs may be drilled. NX/NW size coring equipment is the most commonly used size.
- When soft materials are encountered that produce less than 50 percent recovery, stop the core
 drilling. If soil samples are desired, secure such samples in accordance with the procedures
 described in ASTM Method D 1586 (Split-barrel Sampling) or in Method D 1587 (Thin-Walled Tube
 Sampling); sample soils per SOP SA-1.3. Resume diamond core drilling when refusal materials are
 again encountered.
- Since rock structures and the occurrence of seams, fissures, cavities, and broken areas are among the most important items to be detected and described, take special care to obtain and record these features. If such broken zones or cavities prevent further advance of the boring, one of the following three steps shall be taken: (1) cement the hole; (2) ream and case; or (3) case and advance with the next smaller size core barrel, as conditions warrant.
- In soft, seamy, or otherwise unsound rock, where core recovery may be difficult, M-design core barrels may be used. In hard, sound rock where a high percentage of core recovery is anticipated, the single-tube core barrel may be employed.

5.7.2 Rock Sample Preparation and Documentation

Once the rock coring has been completed and the core recovered, the rock core shall be carefully removed from the barrel, placed in a core tray (previously labeled "top" and "bottom" to avoid confusion), classified, and measured for percentage of recovery as well as the rock quality designation (RQD). Each core shall be described, classified, and logged using a uniform system as presented in SOP GH-1.5. If moisture content will be determined or if it is desirable to prevent drying (e.g., to prevent shrinkage of clay formations) or oxidation of the core, the core shall be wrapped in plastic sleeves immediately after logging. Each plastic sleeve shall be labeled with indelible ink. The boring number, run number, and the footage represented in each sleeve shall be included, as well as designating the top and bottom of the core run.

After sampling, rock cores shall be placed in the sequence of recovery in well-constructed wooden boxes provided by the drilling contractor. Rock cores from two different borings shall not be placed in the same

Subject SOIL AND ROCK	Number GH-1.3	Page 23 of 26
DRILLING METHODS	Revision 2	Effective Date 01/2012

core box unless accepted by the Project Geologist. The core boxes shall be constructed to accommodate at least 20 linear feet of core in rows of approximately 5 feet each and shall be constructed with hinged tops secured with screws, and a latch (usually a hook and eye) to keep the top securely fastened down. Wood partitions shall be placed at the end of each core run and between rows.

The depth from the surface of the boring to the top and bottom of the drill run and run number shall be marked on the wooden partitions with indelible ink. A wooden partition (wooden block) shall be placed at the end of each run with the depth of the bottom of the run written on the block. These blocks will serve to separate successive core runs and indicate depth intervals for each run. The order of placing cores shall be the same in all core boxes. Rock core shall be placed in the box so that, when the box is open, with the inside of the lid facing the observer, the top of the cored interval contained within the box is in the upper left corner of the box, and the bottom of the cored interval is in the lower right corner of the box. The top and bottom of each core obtained and its true depth shall be clearly and permanently marked on each box. The width of each row must be compatible with the core diameter to prevent lateral movement of the core in the box. Similarly, an empty space in a row shall be filled with an appropriate filler material or spacers to prevent longitudinal movement of the core in the box.

The inside and outside of the core-box lid shall be marked by indelible ink to show all pertinent data on the box's contents. At a minimum, the following information shall be included:

- Project name.
- Project number.
- Boring number.
- Run numbers.
- Footage (depths).
- Recovery.
- RQD (%).
- Box number and total number of boxes for that boring (Example: Box 5 of 7).

For easy retrieval when core boxes are stacked, the sides and ends of the box shall also be labeled and include project number, boring number, top and bottom depths of core and box number.

Prior to final closing of the core box, a photograph of the recovered core and the labeling on the inside cover shall be taken. If moisture content is not critical, the core shall be wetted and wiped clean for the photograph. (This will help to show true colors and bedding features in the cores).

6.0 REFERENCES

Acker Drill Co., 1958. Basic Procedures of Soil Sampling. Acker Drill Co., Scranton, Pennsylvania.

American Institute of Steel Construction, 1978. <u>Manual of Steel Construction</u>, 7th Edition. American Institute of Steel Construction, New York, New York.

American Society for Testing and Materials, 1987. <u>ASTM Standards D1587-83, D1586-84, and D1452-80</u>. ASTM Annual Book of Standards, ASTM, Philadelphia, Pennsylvania, Vol. 4.08.

American Society for Testing and Materials, 1989. <u>Standard Practice for Diamond Core Drilling for Site Investigation</u>. ASTM Method D2113-83 (reapproved 1987), Annual Book of Standards, ASTM, Philadelphia, Pennsylvania.

Barcelona, M. J., J. P. Gibb and R. A. Miller, 1983. <u>A Guide to the Selection of Material for Monitoring Well Construction and Ground Water Sampling</u>. ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

Subject	Number	Page
SOIL AND ROCK DRILLING METHODS	GH-1.3	24 of 26
	Revision	Effective Date
	2	01/2012

BOART Longyear Co., Sonic Drilling. Environmental Drilling Division, Andova, Minnesota.

Central Mine Equipment Company, <u>Drilling Equipment</u>, St. Louis, Missouri.

Dept. of the Navy, Naval Facilities Engineering Command, 1982. Soil Mechanics Design Manual 7.1.

Driscoll, Fletcher G., 1986. Groundwater and Wells, 2nd Edition. Johnson Division, St. Paul, Minnesota.

Procedure GH-1.5 - Borehole and Sample Logging.

Scalf, M. R., J. F. McNabb, W. J. Dunlap, R. L. Crosby and J. Fryberger, 1981. <u>Manual of Ground-Water Sampling Procedures</u>. NWWA/EPA Series. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. EPA, Ada, Oklahoma.

- U.S. Department of the Interior, 1974, <u>Earth Manual</u>, A Water Resources Technical Publication, 810 pages.
- U.S. EPA, 1980. <u>Procedure Manual for Ground Water Monitoring at Solid Waste Disposal Facilities</u>. SW-611. Office of Solid Waste, U.S. EPA, Cincinnati, Ohio.
- W. L. Acker III, 1974. <u>Basic Procedures for Soil Sampling and Core Drilling</u>. Acker Drill Co., Inc., Scranton, Pennsylvania.

Subject	Number	Page
SOIL AND ROCK DRILLING METHODS	GH-1.3	25 of 26
	Revision	Effective Date
	2	01/2012

ATTACHMENT A

DRILLING EQUIPMENT SIZES

Drilling Component	Designation or Hole Size (Inches)	O.D. (Inches)	I.D. (Inches)	Coupling I.D. (Inches)
Hollow-stem augers (Ref. 7)	6 1/4	5	2 1/4	,
,	6 3/4	5 3/4	2 3/4	
	7 1/4	6 1/4	3 1/4	
	13 1/4	12	6	
Thin Wall Tube Samplers (Ref. 7)		2	1 7/8	
,		2 1/2	2 3/8	
		3	2 7/8	
		3 1/2	3 3/8	
		4 1/2	4 3/8	
		5	4 3/4	
Drill Rods (Ref. 7)	RW	1 3/32	23/32	13/32
	EW	1 3/8	15/16	7/16
	AW	1 3/4	1 1/4	5/8
	BW	2 1/8	1 3/4	3/4
	NW	2 5/8	2 1/4	1 3/8
	HW	3 1/2	3 1/16	2 3/8
	E	1 5/16	7/8	7/16
	Α	1 5/8	1 1/8	9/16
	В	1 7/8	1 1/4	5/8
	N	2 3/8	2	1
				Wall Thickness (Inches)
Driven External Coupled Extra Strong Steel* Casing (Ref. 8)	2 1/2	2.875	2.323	0.276
	3	3.5	2.9	0.300
	3 1/2	4.0	3.364	0.318
	4	4.5	3.826	0.337
	5	5.63	4.813	0.375
	6	6.625	5.761	0.432
	8	8.625	7.625	0.500
	10	10.750	9.750	0.500
	12	12.750	11.750	0.500

^{*} Add twice the casing wall thickness to casing O.D. to obtain the approximate O.D. of the external pipe couplings.

ATTACHMENT A
DRILLING EQUIPMENT SIZES

Subject	Number	Page
SOIL AND ROCK	GH-1.3	26 of 26
DRILLING METHODS	Revision	Effective Date
	2	01/2012

PAGE TWO

Drilling Component	Designation or Hole Size (Inches)	O.D. (Inches)	I.D. (Inches)	Coupling I.D. (Inches)
Flush Coupled Casing (Ref. 7)	RX	1 7/16	1 3/16	1 3/16
	EX	1 13/16	1 5/8	1 1/2
	AX	2 1/4	2	1 29/32
	ВХ	2 7/8	2 9/16	2 3/8
	NX	3 1/2	3 3/16	3
	HX	4 1/2	4 1/8	3 15/16
Flush Joint Casing (Ref. 7)	RW	1 7/16	1 3/16	
	EW	1 13/16	1 1/2	
	AW	2 1/4	1 29/32	
	BW	2 7/8	2 3/8	
	NW	3 1/2	3	
	HW	4 1/2	4	
	PW	5 1/2	5	
	SW	6 5/8	6	
	UW	7 5/8	7	
	ZW	8 5/8	8	
Diamond Core Barrels (Ref. 7)	EWM	1 1/2	7/8**	
	AWM	1 7/8	1 1/8**	
	BWM	2 3/8	1 5/8**	
	NWM	3	2 1/8	
	HWG	3 7/8	3	
	2 3/4 x 3 7/8	3 7/8	2 11/16	
	4 x 5 1/2	5 1/2	3 15/16	
	6 x 7 3/4	7 3/4	5 15/16	
	AQ (wireline)	1 57/64	1 1/16**	
	BQ (wireline)	2 23/64	1 7/16**	
	NQ (wireline)	2 63/64	1 7/8	
	HQ (wireline)	3 25/32	2 1/2	

^{**} Because of the fragile nature of the core and the difficulty to identify rock details, use of small-diameter core (1 3/8") is not recommended.



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STANDARD OPERATING PROCEDURES

Number	Page
GH-1.5	1 of 20
Effective Date	Revision
06/99	1

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Approved

D. Senovich

Subject

BOREHOLE AND SAMPLE LOGGING

TABLE OF CONTENTS

SEC	TION		PAGE
1.0	PURPOS	E	3
2.0	SCOPE		3
3.0	GLOSSA	RY	3
4.0	RESPON	SIBILITIES	3
5.0	PROCED	URES	3
	5.1	MATERIALS NEEDED	3
	5.2	CLASSIFICATION OF SOILS	
	5.2.1	USCS Classification	6
	5.2.2	Color	
	5.2.3	Relative Density and Consistency	6
	5.2.4	Weight Percentages	7
	5.2.5	Moisture	10
	5.2.6	Stratification	
	5.2.7	Texture/Fabric/Bedding	
	5.2.8	Summary of Soil Classification	
	5.3	CLASSIFICATION OF ROCKS	
	5.3.1	Rock Type	13
	5.3.2	Color	
	5.3.3	Bedding Thickness	
	5.3.4	Hardness	
	5.3.5	Fracturing	
	5.3.6	Weathering	
	5.3.7	Other Characteristics	17
	5.3.8	Additional Terms Used in the Description of Rock	18
	5.4	ABBREVIATIONS	19
	5.5	BORING LOGS AND DOCUMENTATION	19
	5.5.1	Soil Classification	
	5.5.2	Rock Classification	23
	5.5.3	Classification of Soil and Rock from Drill Cuttings	24
	5.6	REVIEW	24
6.0	REFEREN	NCES	24
7.0	RECORD	S	25

Subject	Number	Page
	GH-1.5	2 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

TABLE OF CONTENTS (Continued)

FIGURES

NUMBERS	PAGE
1 BORING LOG (EXA	MPLE)4
	PR COHESIVE SOILS8
3 BEDDING THICKN	ESS CLASSIFICATION10
4 GRAIN SIZE CLAS	SIFICATION FOR ROCKS12
	ING LOG (EXAMPLE)17

Subject	Number	Page
	GH-1.5	3 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

<u>Site Geologist</u>. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 <u>Materials Needed</u>

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCI)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

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Subject	Number	Page
	GH-1.5	4 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

		H					BORING LOG			Page		_ of	
		NAME:					BORING N	NUMBER	₹:				
		NUMBE COMPA					DATE: GEOLOGI	ст. —					
	ING I		INT.				DRILLER:	_					
		<u> </u>		r====		MATE	RIAL DESCRIPTION	-ı - f =		T PID/I	FID Re	ading	(maa)
ample o. and ope or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	Sample	Sampler BZ		Driller BZ**
_	:	\geq					W	- :		<u></u>	<u> </u>		
						ll		_ _ .			<u> </u> _	<u> </u>	
						ا_ا		_ _ .			<u> </u> _	<u> </u>	
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nclud		ng, enter ro or reading in			ehole. Increa	se readi	ng frequency if elevated response-read.		[Backgro	Orilling A	rea m):	• — ·	L 1

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FIGURE 1 (CONTINUED)

SOIL TERMS

				UNHEDSU	LCLASSIFICATION	(USCS)					
	COURSE-GRUNED SOILS More Than Half of Material is LA ROSER Than No. 200 Sieve Size					More Than Half of Material is SMALLER Than No. 200 Sieve Size					
(Excludin		TIONPROCEDURES and Beating Procisions on Estimated Chelytics	GROUP SAMBOL	TY KAL NAMES		FELD DENTFICAT (Excluding Particles Larger Than) Inches as		Celgita)	GROUP SYMBOL	THY CALL NAMES	
					·	identification Procedures on Fracti-	on Samalier than No. 4º Sieve Size				
					-	DAYSTREMSTH(Crushing Chanadorbiba)	D LA TANCY (Reaction to Shaling)	TOUGHNESS (Coredite no) Near Pleat clumb			
ORAUELS (*****) 147g	CLEAN GRAVELS (Low% Fines)	Olde range in grain size and substantial amounts of all intermediate particle sizes.	90	Cled graded gravels, gravel-mand mixtures, hitle or no lines.	SLTS AND CLAYS Uguid Untit 45 *	None to Silght	Constant to Slow	None	ML	hosparic sites and very the search, rock four, sity or obeyey the search with slight photochy.	
		Predominantly one size or a range of sizes with some informed size smitssing.	OP.	Poorly graded gravels, gravel-mand mixtures, hitse or no lines.		ké dum to High	None to Very Slow	Medium	CL	hosparic days of lowto medium placifyly, gravelly days, sandy days, silly days, kan days.	
	GRAVELS(V.F.NES (High %Fines)	No replication them (for identification procedures, see lot.)	GMI	Sity gravels, poorly grade digravel-sand-sitt midures.		Sal gritto lule dium	Slow	Salphit	OL	Organic diteand organic sit-days of low placticity.	
		Pleatic then (for identification procedures, see CL)	90	Clayery graveby, proofly graded gravel-sound-day militures.	SLTS AND CLAYS Uquid Limity 5 •	Sil ghitto ble dium	Stouto None	Sight to Medium	MH	inorganic sitis, micaceous or distrinsceous line sandy or sity soils, elactic sitis.	
SANDS 5+3(+): 14*g	CLEAN SANDS (Low/KFINE)	Olde range in grain size and substantial amounts of all informed late particle sizes.	80	Cled graded sand, gravely sands, little or no fires.		High to Very High	None	Hgh	ан	Inorganii calegra offisigh planticity, fit dayra.	
		Predominantly one size or a range of sizes with some informediate size smissing.	3*	Poorly graded sands, gravely sands, little or no fines.		ké dumb High	None to Very Sow	Slight to Medium	ОН	Organic days of medium to high placificity.	
	SANDS() FINES (High %Fines)	No replication there (for identification procedures, see MCL)	811	Sity mands, poorly graded mand mit mixtures.	HIGHLYORGANIC SO LS	Readilyidenii fed by color, odor, spongy 6	el and fequently by libroustexture		Pt	Peat and other organic solts	
		Plantic Then (for Identification procedures, see CL)	80	Clayery manufactor or by gas ded mand-clay mixtures.							

Boundary classifications: Soits prosecuting characteristics of two groups are designated by combining group symbols. For example, 90990, well graded gravel-sand mixture with day binder.

All sleve sizes on this chartere U.S. Stander

DENSITY OF GRANULAR SOILS					
DESIGNATON	STANDARD PENE TRATION RESISTANCE- BLOUSSPOOT				
Very Lorge	1-4				
Loose	5-10				
Medium Lorge	11-) =				
Derme	381				
Very Democ	Over5x				

CONSISTENCY OF COHESIVE SOILS								
CONSISTENCY	UNC COMPRESSIVE STRENG TH (TONS/BD.FT.)	STANDARD FENE TRATTON RESISTANCE- BLOUSSFOOT	FELD DENTFCATON NETHCOS					
Very Soit	Less than 1 25	* to 2	Easily pendimbed several indices by Bit					
Sot	#25to#5#	2 to 4	Easily pendinated several inches by flumb .					
MedumStif	# 5# to 1#	4to 2	Can be peretrated several inches by frumb.					
SHF	1.a to 2.a	2 to 8	Readly indented by frumb.					
Very Staff	ž ato 4a	15 to) =	Readly indented by frumbrial .					
Hard	More than 4a	0ver) •	h dented with diffranty by thumbroal.					

Subject

BOREHOLE AND SAMPLE LOGGING

Revision

Effective Date 06/99

5 of 20

GH-1.5

ROCKTERMS

ROCK HARDNESS (FROM CORE SAMPLES)		ROCK BROKENNESS			
Descriptive Terms	Sciewalther or Kini & Ellecta	Hemmer E Richs	Descriptive Terms	Abbrevission	Specing
Sof	Easily Grouped	Crushes when pressed with hammer	Very Broken	(V.Br.)	15.
Medium Sof	Can be Gouged	Becalar(one blood); crumbly edges	Bolen	(Br.)	25-7
Me dium Herd	Can be stratched	Be talls (one blow); strarp edges	Biodry	(81)	19"
Herd	Carnot be soratched	Be als condrol/daily (several Mous); sharp edges	Mandue	940),,

D:	SOL SHAPLES - TYES	ROCK SAMPLES - TYPES	_	UA TER LEUELS		
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Subject	Number	Page
	GH-1.5	
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as " $(1/4 \text{ inch}\Phi-1/2 \text{ inch}\Phi)$ " or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.3. Those designations are:

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Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight	
Trace	0 - 10 percent	
Some	11 - 30 percent	
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent	

019611/P Tetra Tech NUS, Inc.

Subject	Number	Page
	GH-1.5	8 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

FIGURE 2 CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

Subject BOREHOLE AND SAMPLE LOGGING	Number GH-1.5	Page 9 of 20
	Revision 1	Effective Date 06/99

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

Subject	Number	Page
	GH-1.5	10 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

FIGURE 3
BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

Subject	Number	Page
DODELIOLE AND GAMES - 1 000000	GH-1.5	11 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale A fissile very fine-grained rock. Fractures along bedding planes.
- Limestone Rock made up predominantly of calcite (CaCO₃). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal Rock consisting mainly of organic remains.
- Others Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

019611/P Tetra Tech NUS, Inc.

Subject	Number GH-1.5	Page 12 of 20
BOREHOLE AND SAMPLE LOGGING	Revision 1	Effective Date 06/99

FIGURE 4

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter		
Cobbles	> 64 mm		
Pebbles	4 - 64 mm		
Granules	2 - 4 mm		
Very Coarse Sand	1 - 2 mm		
Coarse Sand	0.5 - 1 mm		
Medium Sand	0.25 - 0.5 mm		
Fine Sand	0.125 - 0.25 mm		
Very Fine Sand	0.0625 - 0.125 mm		
Silt	0.0039 - 0.0625 mm		

After Wentworth, 1922

Subject	Number	Page
	GH-1.5	13 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail.
 Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).
- Medium soft Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.
- Medium hard No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.
- Hard Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the works "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) Less than 2-inch spacing between fractures
- Broken (BR.) 2-inch to 1-foot spacing between fractures
- Blocky (BL.) 1- to 3-foot spacing between fractures
- Massive (M.) 3 to 10-foot spacing between fractures

Subject	Number GH-1.5	Page 14 of 20
BOREHOLE AND SAMPLE LOGGING	Revision 1	Effective Date 06/99

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD (After Deere, 1964)

 $RQD \% = r/l \times 100$

- r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.
- I = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

Subject	Number	Page
	GH-1.5	15 of 20
BOREHOLE AND SAMPLE LOGGING	Revision	Effective Date
	1	06/99

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam Thin (12 inches or less), probably continuous layer.
- Some Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."
- Few Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."
- Interbedded Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."
- Interlayered Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.
- Rhyolite A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.
- Granite A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.
- Diorite A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.
- Gabbro A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

Subject	Number GH-1.5	Page 16 of 20
BOREHOLE AND SAMPLE LOGGING	Revision 1	Effective Date 06/99

5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

С	-	Coarse	Lt	-	Light	YI	-	Yellow
Med	-	Medium	BR	-	Broken	Or	-	Orange
F	-	Fine	BL	-	Blocky	SS	-	Sandstone
V	-	Very	М	-	Massive	Sh	-	Shale
SI	-	Slight	Br	-	Brown	LS	-	Limestone
Осс	-	Occasional	ВІ	-	Black	Fgr	-	Fine-grained
Tr	-	Trace						

5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.
- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.
- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.
- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt
 was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this
 increment. This information is helpful in the construction of cross-sections. As an alternative,
 symbols may be used to identify each change in lithology.
- The density of granular soils is obtained by adding the number of blows for the last two increments.
 Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer
 also to the back of log sheet Consistency of Cohesive Soils. Enter this information under the
 appropriate column. Refer to Section 5.2.3.

019611/P Tetra Tech NUS, Inc.

Subject	Number GH-1.5	Page 17 of 20
BOREHOLE AND SAMPLE LOGGING	Revision 1	Effective Date 06/99

FIGURE 5 COMPLETED BORING LOG (EXAMPLE)																	
BORING LOG Page 1 of 1																	
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Subject	Number	Page
	GH-1.5	18 of 20
BOREHOLE AND SAMPLE LOGGING	Revision *	Effective Date
	1	06/99

- Enter color of the material in the appropriate column.
- Describe material using the USCS. Limit this column for sample description only. The predominant material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:

Trace: 0 - 10 percent
 Some: 11 - 30 percent
 And/Or: 31 - 50 percent

- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.
- Enter USCS symbol use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.
- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:
 - Moisture estimate moisture content using the following terms dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.
 - Angularity describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.
 - Particle shape flat, elongated, or flat and elongated.
 - Maximum particle size or dimension.
 - Water level observations.
 - Reaction with HCI none, weak, or strong.
- Additional comments:
 - Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.
 - Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.
 - Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.
 - At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

Subject	Number GH-1.5	Page 19 of 20
BOREHOLE AND SAMPLE LOGGING	Revision 1	Effective Date 06/99

- Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.
- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

- Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.
- Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.
- Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.
- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.
- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.
- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.
- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:
 - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.
 - Indicate calcareous zones, description of any cavities or vugs.
 - Indicate any loss or gain of drill water.
 - Indicate drop of drill tools or change in color of drill water.
- Remarks at the bottom of Boring Log shall include:
 - Type and size of core obtained.
 - Depth casing was set.
 - Type of rig used.
- As a final check the boring log shall include the following:
 - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.
 - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

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Subject	Number GH-1.5	Page 20 of 20
BOREHOLE AND SAMPLE LOGGING	Revision 1	Effective Date 06/99

5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to
 obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future
 reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely
 examined to determine general lithology.
- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

6.0 REFERENCES

Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

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STANDARD OPERATING PROCEDURE

MUNITIONS RESPONSE PROGRAM (MRP) SOP 05

GPS DATA COLLECTION AND TRANSFER

1.0 OVERVIEW

The primary purpose of this Standard Operating Procedure (SOP) is to provide the Field Technicians with

basic instructions for operating a handheld Global Positioning System (GPS) unit allowing them to set

GPS parameters in the receiver, record GPS positions on the field device, and transfer the data for

integration into existing Geographic Information System (GIS) figures.

This SOP is specific to GIS quality data collection for Trimble-specific hardware and software.

If possible, the Trimble GeoXT or XH Operators Manual should be downloaded onto the operator's

personal computer for reference before or while in the field. The manual can be downloaded at the

following website:

http://trl.trimble.com/docushare/dsweb/Get/Document-311749/TerraSyncReferenceManual.pdf

Unless the operator is proficient in the setup and operation of the GPS unit, the Project Manager (or

designee) should have the GPS unit shipped to the project-specific contact listed below in the Pittsburgh,

Pennsylvania office at least five working days prior to field mobilization so project-specific data files (i.e.

shape files), background images, data dictionaries, and correct coordinate systems can be uploaded into

the unit.

Tetra Tech NUS

Attn: Ralph Basinski

661 Anderson Drive, Bldg #7

Pittsburgh, PA 15220

The SOP also describes how field collected data is to be transferred through the use of the MRP Website.

(http://www.ttnus.com/MRPRepository/). This website serves as a centralized portal to facilitate data

exchange for field personnel, GIS staff, and project managers. The website contains a "Reference" page

that will contain the latest version of this SOP and other valuable documentation.

For technical questions regarding operation of the GPS units, data collection, general questions about

this SOP, and use of the MRP website, please contact Kevin Moore (kevin.moore@tetratech.com).

1

2.0 REQUIRED EQUIPMENT

The following hardware and software should be utilized for locating and establishing GPS points in the field:

2.1 GPS Hardware & Equipment

- Hand-held GPS Unit capable of sub-meter accuracy. This includes the docking cradle, a/c adapter, stylus, and USB cable for data transfer. Two models, the GeoXH and GeoXT, are acceptable for use.
 The XH yields higher accuracy (in both real-time and post-processed) and should always be requested when highly precise data is required.
- An external antenna will yield better satellite reception, especially in heavy tree canopy. Associated accessories include a range pole and hardware clamp, for mounting the GPS unit to the pole.
- Indelible marker.
- Non-metallic pin flags for temporary marking of positions.

2.2 **GPS Software**

The following software is required to transfer data from the handheld GPS unit to a personal computer:

- Trimble TerraSync version 2.6 or later (pre-loaded onto GPS unit from vendor)
- Microsoft ActiveSync version 4.5 or later. Download to personal computer from:
 http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/activesync-download.mspx

Note: Windows Vista and Windows 7 users should download Windows Mobile Device Center version 6.1 or later from the following site, if it is not already loaded on the machine:

http://www.microsoft.com/windowsmobile/en-us/downloads/microsoft/device-center-download.mspx

- Trimble Data Transfer Utility (<u>freeware version 2.1 or later</u>). Download to personal computer from: http://www.trimble.com/datatransfer.shtml

3.0 START-UP PROCEDURES

Prior to utilizing the GPS in the field, ensure the unit is fully charged. The unit may come charged from the vendor, but an overnight charge is recommended prior to fieldwork.

The Geo-series GPS units require a docking cradle for both charging and data transfer. The Geo-series GPS unit is docked in the cradle by first inserting the far domed end in the top of the cradled, then gently seating the contact end into the latch. The power charger is then connected to the cradle at the back end using the twist-lock connector. Attach a USB cable as needed between the cradle (B end) and the laptop/PC (A end).

It is recommended that the user also be familiar and check various Windows Mobile settings. One critical setting is the Power Options. The backlight should be set as needed to conserve power when not in use.

3.1 <u>Initial Start Up</u>

- 1) Power on the GPS unit by pushing the small green button located on the lower right front of the unit.
- 2) Utilizing the stylus that came with the GPS unit, launch **TerraSync** from the Windows Operating System by tapping on the start icon located in the upper left hand corner of the screen and then tap on **TerraSync** from the drop-down list.
- 3) If the unit does not default to the Setup screen, tap the Main Menu (uppermost left tab, just below the Windows icon) and select Setup.
- 4) If the unit was previously shipped to the Pittsburgh office for setup, you can skip directly to Section 4.0. However, to confirm or change settings, continue on to Section 3.1.

3.2 Confirm Setup Settings

Use the Setup section to confirm the TerraSync software settings. To open the Setup section, tap the Main Menu and select Setup. (Note that if the unit was shipped from the Pittsburgh office, these settings should have been set for your specific project. Feel free to contact Pittsburgh staff with any questions.)

- 1) Tap on the Coordinate System.
- 2) Verify the project specs are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu. Note: It is always best to utilize the Cancel tab rather than the OK tab if no changes are made since configurations are easily changed by mistake.
- 3) Tap on the Units.

- 4) Verify the user preferences are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
- 5) Tap Real-time Settings.
- 6) Verify the Real-time Settings are correct for your specific project by scrolling through the various settings. Edit as needed and then tap OK; otherwise, tap Cancel to return to Setup Menu.
- 7) The GPS unit is now configured correctly for your specific project.

3.3 Antenna Connection

- 1) If a connection has been properly made with the internal antenna, a satellite icon along with the number of usable satellites will appear at the top of the screen next to the battery icon. If no connection is made (e.g.: no satellite icon), tap on the GPS tab to connect antenna.
- 2) At this point the GPS unit is ready to begin collecting data.

3.4 Loading a Background file

This section provides instructions on pulling in a pre-loaded background file. These files are helpful in visualizing your current location.

- 1) From the Main Menu select Map, then tap on Layers, select the background file from drop down list.
- 2) Select the project-specific background file from the list of available files.
- 3) Once the selected background file appears, the operator can manipulate the screen utilizing the +/- and <-/-> functions at the bottom of the screen.
- 4) In operating mode, the operator's location will show up on the background file as a floating "x".

4.0 FIELD DATA COLLECTION

For MRP data collection activities, a new GPS file should be created **every day** and transferred **nightly** using the MRP website (see Section 9.0). This is to insure the timely transfer of data, file organization in the database, and allow for next-day GIS mapping. Also, individual GPS data files should be **unique to a particular site** or unit (typically a UXO number). If multiple sites are visited in a single data, multiple files should be created.

4.1 <u>Creating a Data File</u>

- 1) From the Main Menu select Data.
- 2) From the Sub Menu (located below the Data tab) select New which will bring up the New Data File menu.
- 3) An auto-generated filename appears and should be edited for your specific project. The following naming convention should be followed as closely as possible: **IH-UXO4-01012010-TeamA**, where "IH" is the installation abbreviation (Indian Head), "UXO04" is the site, and "01012010" is the data in MMDDYYYY format. If multiple teams are being deployed across an individual site on the same day, it is important to specify the field team name at the end of the file name ("TeamA"). If the integral keyboard does not appear, tap the small keyboard icon at the bottom of the screen.
- 4) Select the data dictionary that will be used to collect features. The data dictionary provides predefined fields and drop-down menus to facilitate data collection as it relates to specific MRP data types. The MRP data dictionary is entitled "MRP Data Collection" and should appear in the data dictionary drop-down list. This should have been pre-loaded into the GPS prior to use. The data dictionary file is available on the MRP website under the "Reference" section.
- 5) After entering the file name and selecting the data dictionary, tap Create to create the new file.
- 6) Confirm antenna height if screen appears. Antenna height is the height that the GPS unit will be held from the ground surface (Typically 3 to 4 feet)
- 7) The Choose Feature screen appears.

4.2 <u>Collecting Features</u>

- 1) If not already open, the Collect Feature screen can be opened by tapping the Main Menu and selecting Data. The Sub Menu should default to Collect.
- 2) <u>Do not</u> begin the data logging process until you are at the specific location for which you intend to log the data.
- 3) A known reference or two should be shot at the beginning and at the end of each day in which the GPS unit is being used. This allows for greater accuracy during post-processing of the data.

- 4) Upon arriving at the specific location, select the proper feature type from the data dictionary list (MEP Object, Transect End Point, GPS QC Point, or General Point).
- 5) Tap Create to begin data logging.
- 6) As the GPS is collecting positions, enter the feature attributes, starting with the Item ID. This field is required and will not allow the user to continue or save the position without entering a value. Enter any additional notes or feature descriptions in the appropriate fields.
- 7) Data logging can be confirmed by viewing the writing pencil icon in the upper part of the screen. Also, the logging counter will begin. As a Rule of Thumb, accumulate a minimum of 20 readings on the counter, per point, as indicated by the logging counter before saving the GPS data.
- 8) Once the counter has reached a minimum number of counts (i.e. 20), tap on OK to save the data point to the GPS unit. Confirm the feature. All data points are automatically saved within the GPS unit.
- 9) Repeat steps 2 through 8, giving each data point a unique name or number.

Note: If the small satellite icon or the pencil icon is blinking, this is an indication the GPS unit is not collecting data. A possible problem may be too few satellites. While still in data collection mode, tap on Main Menu in upper left hand corner of the screen and select Status. Skyplot will display as the default showing the number of available satellites. To increase productivity (number of usable satellites) use the stylus to move the pointer on the productivity and precision line to the left. This will decrease precision, but increase productivity. The precision and productivity of the GPS unit can be adjusted as the number of usable satellites changes throughout the day. To determine if GPS is correctly recording data, see Section 5.2. If the precision toggle is decreased, the user should frequently check the Skyplot display to restore the default values as soon as possible.

4.3 <u>Navigation</u>

This section provides instructions on navigating to saved data points in an existing file within the GPS unit.

- 1) From the Main Menu select Map.
- 2) Using the Select tool, pick the point on the map to where you want to navigate.
- 3) The location you select will have a box placed around the point.

- 4) From the Options menu, choose the Set Nav Target (aka set navigation target).
- The location will now have double blue flags indicating this point is you navigation target.
- 6) From the Main Menu select Navigation.
- 7) The dial and data on this page will indicate what distance and direction you need to travel to reach the desired target.
- 8) Follow the navigation guide until you reach the point you select.
- 9) Repeat as needed for any map point by going back to Step 1.

4.4 <u>Data Quality Control</u>

Quality control checks should be performed each day of data collection and/or data navigation. QC checks are important both to understand real-time accuracy while in the field, and also to provide control data needed during post-processing.

- Known survey benchmarks, surveyed monitoring wells, or other established and documented control
 points should be identified
- 2) GPS equipment should be placed on known control points and positions recorded
- 3) For data collection tasks QC check data should be collected at least at the start and completion of the fieldwork for the day of data collection. Additional occupation and collection of control point data should occur as possible during the work day, and should increase in frequency as the number of data points increase and the need for accurate data collection increases
- 4) For navigation tasks such as stake placement for planned sample locations, QC data checks should be done at least at the start and completion of the fieldwork for each day. Known visible targets should be occupied and observed by the user, while the GPS satellite status and other user interface data is reviewed. The user should assess whether the real-time accuracy settings on the GPS are within the tolerance of the observed visual reference points.

4.5 <u>Viewing Data or Entering Additional Data Points to the Current File</u>

- 1) To view the stored data points in the current file, tap on the Main Menu and select Map. Stored data points for that particular file will appear. Use the +/- and <-/-> icons in lower left hand corner of screen to zoom in/out and to manipulate current view.
- 2) To return to data collection, tap on the Main Menu and select Data. You are now ready to continue to collect additional data points.

4.6 <u>Viewing Data or Entering Data Points from an Existing File</u>

- 1) To view data points from a previous file, tap on Main Menu and select Data, then select File Manager from the Sub Menu.
- 2) Highlight the file you want to view and select Map from the Main Menu.
- 3) To add data points to this file, tap on Main Menu and select Data. Continue to collect additional data points.

4.7 Shutting Down

This section provides instruction for properly shutting down the GPS unit.

- 1) When shutting down the GPS unit for the day, first click on the "X" in the upper right hand corner.
- 2) You will be prompted to ensure you want to exit TerraSync. Select Yes.
- 3) Power off the GPS unit by pushing the small green button located on the bottom face of the unit.
- 4) Place the GPS unit in its cradle to recharge the battery overnight. Ensure the green charge light is visible on the charging cradle.

5.0 DATA TRANSFER

This section describes how data should be downloaded from the GPS units and uploaded to a central website for post-processing and integration into GIS datasets. GPS data collected on a given day should be transferred that night for post-processing by GIS staff the next morning. Once post-processed, the GPS data will be plotted on a map and be immediately provided to the project team for review. Data upload, download, and review will be facilitated through a secure MRP website: http://www.ttnus.com/MRPRepository/

5.1 Load Data from the GPS Unit to Your Computer

- 1) Install the Data Transfer and ActiveSync software installed on your PC (see section 2.2)
- 2) Connect the GeoXH/XT to your PC via an A/B USB cable (blade end and square end type "HP printer" style)
- 3) ActiveSync should auto-detect the connection and recognize the data collector
- 4) Make sure the data file desired is CLOSED in TerraSync prior to transfer

- 5) Connect via ActiveSync as a guest (not a partnership)
- 6) Run the Trimble Data Transfer Utility program on your PC
- 7) Select "GIS Datalogger on Windows CE" or similar selection
- 8) Hit the green connect icon to the right the far right area should say "Connected to" if successful
- 9) Select the "*Receive*" data tab (under device)
- 10) Select "Data" from file types on the right
- 11) Find the file(s) needed for data transfer. You can sort the data files by clicking on the date/time header
- 12) Select or browse to a C-drive folder you can put this file for upload
- 13) When the file appears on the list, hit the "*Transfer All*". Once complete, a packet of multiple data files will appear on your computer in the specified folder.

5.2 Gain Access to MRP Website

- 1) Confirm that your computer has internet access
- 2) Click on the following link: http://www.ttnus.com/MRPRepository/
- 3) To register for the website, click on the "Register here" link. Enter your information and click "Submit." NOTE: Requests for registration are sent to Ralph Basinski, Program Manager, for approval. Please contact mark.maguire@tetratech.com if you experience any access issues.
- 4) Enter your username (Tetra Tech email address) and password to log in.

5.3 Upload GPS Data from Your Computer to the MRP Website

- 1) From the main page, select "Upload" from the menu at left.
- 2) Select the type of data you are uploading, typically "GPS Field Data"
- 3) Select the appropriate Installation and Site. Remember that GPS files should be unique for each site, even if multiple sites are visited in one day. If collected data is not associated with a site, select "Other."

- 4) Select "browse" to navigate to the appropriate *.SSF file on your computer. When you use the Trimble download utility to grab data from the GPS unit, multiple files will appear on your computer. You only need to the upload the *.SSF file.
- 5) Populate the "Comments" field to describe the dataset and any other pertinent information. This information will be provided to the GIS analyst who will be integrating the dataset, so be sure to be as descriptive as possible especially if there are any issues with the data. (For example, if you were to sample 16 points and for some reason you believe only 15 were logged, it is helpful to share this information.)
- 6) Select "Upload." Users will be notified if the files were uploaded successfully.

5.4 <u>Download Data from the MRP Website to Your Computer</u>

The download utility on the MRP website will serve different user types. **Field staff** will use the utility to download GIS figures (in PDF format) and view the previous day(s) field data on aerial photographs, checking for any discrepancies or missing data elements. **Project Managers** will also have the ability to download and view these figures, to visualize the data and track project progress. This utility will also allow **GIS Analysts** to download the *.SSF files posted by field staff for post-processing and map plotting.

To download GIS Figures:

- 1) From the main page, select "Download" from the menu at left.
- 2) Select an Installation and Site
- 3) Users can view Figures for a particular date or by a range of dates, by selecting the `appropriate options. To search all dates, leave all of these fields as the default.
- 4) Select "Search"
- 5) A table will appear showing the files available for download. Simply click on the link to the file and you will be prompted to save it to your computer.



STANDARD OPERATING PROCEDURES

Number	Page
SA-1.1	1 of 34
Effective Date 04/07/2008	Revision 7
	

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Subject

GROUNDWATER SAMPLE ACQUISITION AND ONSITE WATER QUALITY TESTING

Approved

Tom Johnston

TE Johnston

TABLE OF CONTENTS

SECT	ION		<u>PAGE</u>
1.0	PURPO	OSE	2
2.0	SCOPE	<u> </u>	2
3.0	GLOSS	SARY	2
4.0		DNSIBILITIES AND PERSONNEL QUALIFICATIONS	
4.0			
5.0	HEALT	H AND SAFETY	4
6.0	PROCE	EDURES	5
	6.1	General	5
	6.2	Sampling, Monitoring, and Evacuation Equipment	
	6.3	Calculations of Well Volume	
	6.4	Evacuation of Static Water – Purging	
	6.4.1	General	
	6.4.2	Evacuation Devices	
	6.5	Onsite Water Quality Testing	
	6.5.1	Measurement of PH	
	6.5.2	Measurement of Specific Conductance	
	6.5.3	Measurement of Temperature	
·	6.5.4	Measurement of Dissolved Oxygen	17
	6.5.5	Measurement of Oxidation-Reduction Potential	
•	6.5.6	Measurement of Salinity	
	6.5.7	Measurement of Turbidity	
	6.6	Sampling	
	6.6.1	Sampling Plan	
	6.6.2	Sampling Methods as Related to Low-Flow Sampling	
	6.7	Low-Flow Purging and Sampling	
	6.7.1	Scope and Application	25
	6.7.2	Equipment	
	6.7.3	Purging and Sampling Procedure	20
7.0	REFER	RENCES	28
ATTA	CHMENT	<u>s</u>	•
	A	PURGING EQUIPMENT SELECTION	29
	В	GROUNDWATER SAMPLE LOG SHEET	
	C	EQUIPMENT CALIBRATION LOG.	
	D	LOW FLOW PURGE DATA SHEET	

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	2 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process to be used for purging groundwater monitoring wells prior to sampling, for collecting groundwater samples, and for measuring groundwater quality parameters.

2.0 SCOPE

This document provides information on proper sampling equipment, onsite water quality testing, safety measures to ensure the safety of the field technician(s), and techniques for groundwater sampling. All personnel are encouraged to review the information contained herein to facilitate planning of the field sampling effort. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology.

3.0 GLOSSARY

<u>Conductivity</u> – Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions and their total concentration, mobility, valence, and relative concentrations and on temperature. Conductivity is highly dependent on temperature and should be reported at a particular temperature, i.e., 20.2 microSiemens per centimeter (mS/cm) at 14°C.

<u>Dissolved Oxygen (DO)</u> – DO levels in natural and wastewater depend on the physical, chemical, and biochemical activities in the water sample.

<u>Groundwater Sample</u> – A quantity of water removed from the ground, usually via a monitoring well that may or may not be lined with a well casing.

Oxidation-Reduction Potential (ORP) - A measure of the activity ratio of oxidizing and reducing species as determined by the electromotive force developed by a noble metal electrode immersed in water, as referenced against a reference electrode. A reference electrode commonly used in the field is the silver/silver chloride electrode, which has a voltage offset of about 210 mV from the standard hydrogen electrode (SHE). To convert field ORP measurements to equivalent SHE values, approximately 210 mV must be added to the ORP values obtained using the silver/silver chloride electrode. The actual offset depends on the concentration of the potassium chloride (KCI) in the field reference electrode and the temperature. Offsets typically range from 199 (saturated KCI) to 205 (3.5 Molar KCI) to 222 mV (1 Molar KCI) at 25°C and are greater at lower temperatures.

<u>pH</u> - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration.

<u>pH Paper</u> - Indicator paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution's pH.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	3 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

<u>Salinity</u> – The measurement of dissolved salts in a given mass of solution. Note: most field meters determined salinity automatically from conductivity and temperature. The value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent). The parts per thousand symbol $\binom{0}{100}$ is not the same as the percent symbol $\binom{0}{100}$.

<u>Turbidity</u> – Turbidity in water is caused by suspended matter such as clay, silt, and fine organic and inorganic matter. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

<u>Project Manager</u> - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of groundwater samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager identifies sampling locations.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP). This includes but is not be limited to performing air quality monitoring during sampling, boring and excavation activities, and ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the FOL on other safety-related matters regarding sampling, such as mitigative measures to address potential hazards from hazardous objects or conditions.

<u>Project Geologist/Sampler</u> - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

<u>Project Hydrogeologist</u> – This individual is responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), equipment to be used, and providing detailed input in this regard to the project planning documents. The project hydrogeologist is also responsible for properly briefing and overseeing the performance of site sampling personnel.

<u>Field Operations Leader (FOL)</u> – This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather)
 conditions.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	4 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision _	Effective Date
WATER QUALITY TESTING	7	04/07/2008

Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Specific safety and health precautions are identified throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas and roadways and along highways.

Methods of avoiding these hazards are provided below.

Knee injuries – Many monitoring wells are installed as flush mounts. Personnel are required to kneel to open these wells and to take groundwater level measurements, etc. This could result in knee injuries from kneeling on stones/foreign objects and general damage due to stress on the joints. To combat this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample wells. To minimize these hazards:

- Pre-survey well locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations – To prevent cuts and lacerations associated with groundwater sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.
- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- · Keep cutting surfaces clean and smooth.
- Secure items to be cut -- do not hold them against the opposing hand, a leg, or other body part.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	5 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken glass or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards — When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities ASSUME THEY DO NOT SEE YOU OR MEMBERS
 OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site
 personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind
 spot.
- **Provide a required free space of travel**. Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver.
 Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

6.0 PROCEDURES

6.1 General

For information derived from a groundwater sample to be useful and accurate, the sample must be representative of the particular zone being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of analysis to keep any changes in water quality parameters to a minimum.

CAUTION

A closed well may generate and accumulate gases due to biological degradation, evolution of volatile chemicals from groundwater into the air, or other chemical actions. These gases may also be artificially generated, such as in the case of air sparging or extraction wells, which may take several days to depressurize. See Section 6.6.2 for safety measures to be employed to protect sampling personnel.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	6 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision	Effective Date
WATER GOALITT TESTING	/	04/07/2008

Methods for withdrawing samples from completed wells include the use of pumps, compressed air or nitrogen, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water sample due to external influences of the sampling technique(s). In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or easing, and stratification will occur. The well water in the screened section will mix with groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. Concentration gradients resulting from mixing and dispersion processes, layers of variable geologic permeability, and the presence of separate-phase product (e.g., floating hydrocarbons) may eause stratification. Excessive pumping or improper sampling methods can dilute or increase contaminant concentrations in the collected sample compared to what is representative of the integrated water column as it naturally occurs at that point, resulting in the collection of a non-representative sample. To safeguard against collecting non-representative samples, the following approach shall be followed prior to sample acquisition:

CAUTION

Mechanical agitation of well water may cause off-gas generation of volatile contaminants, creating an inhalation exposure to the sampler(s). Where avoiding an inhalation exposure is not possible and mechanical agitation is possible, pump into closed-top containers to control potential air emissions.

- 1. If possible, position yourself (and the sampling equipment) upwind of the well head.
- 2. Purge the monitoring well to be sampled prior to obtaining any samples from it. Evacuation of three to five well volumes is recommended prior to sampling, unless low-flow purging and sampling methods are utilized as described in Section 6.7 (Consult the site-specific SAP for exact purging parameters). In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, extensive evacuation prior to sample withdrawal is not as critical as it is in a low-yielding well or in wells containing stagnant water.
- 3. For wells with low yields that are purged dry during sampling, evacuate the well and allow it to recover to 75 percent of full capacity prior to sample acquisition. If the recovery rate is fairly rapid (generally 300 mL per minute or greater), attempt to continue evacuation until the number of well volumes specified in the SAP is achieved. If this cannot be accomplished, allow recovery to 75 percent of capacity and begin sampling.

CAUTION

For moderate to high-yielding monitoring wells, an evacuation rate that does not cause excessive turbulence in the well should be selected. There is no absolute safeguard against contaminating the sample with stagnant water; hence, special techniques are required for purging to minimize the potential for sample contamination (see below).

- 4. For moderate to high-yielding monitoring wells, use one of the following purge techniques:
 - Place a submersible pump or the intake line of a surface pump or bailer just below the water surface when removing the stagnant water.
 - While purging and as the water level decreases, lower the pump or intake line as the water level drops in the well. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. After this is accomplished, a bailer or other approved device may be used to collect the sample for analysis.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	7 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

• Unless otherwise directed, place the intake line of the sampling pump (or the submersible pump itself) near the center of the screened section, and pump approximately one casing volume of water from the well at a low purge rate equal to the well's recovery rate (low-flow sampling).

6.2 <u>Sampling, Monitoring, and Evacuation Equipment</u>

Sample containers shall conform to the guidelines in SOP SA-6.1.

The following equipment shall be on hand when sampling groundwater wells (reference SOPs SA-6.1 and SA-7.1):

<u>Sample packaging and shipping equipment</u> — Coolers for sample shipping and cooling, chemical
preservatives, appropriate sampling containers and filler materials, ice, labels, and chain-of-custody
documents.

• Field tools and instrumentation

- Multi-parameter water quality meter with an in-line sample chamber capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity, and salinity, or individual meters (as applicable)
- pH Paper
- Camera and film (if appropriate)
- Appropriate keys (for locked wells)
- Water level indicator and/or oil-water interface probe if separate-phase product is expected

Pumps

- Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with drop lines and air-lift apparatus (compressor and tubing) where applicable.
- Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.
- Other sampling equipment Bailers, graduated cylinder, stopwatch, and inert line with tripod-pulley assembly (if necessary).
- Pails Plastic, graduated.
- Clean paper or cotton towels for cleaning equipment.
- <u>Buckets with lids</u> for collecting purge water.
- <u>Decontamination solutions</u> Deionized water, potable water, phosphate-free laboratory-grade detergent, and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, cleaned prior to use, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well purging and sample collection.

019611/P Tetra Tech NUS, Inc.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	8 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision 7	Effective Date 04/07/2008

6.3 Calculations of Well Volume

To ensure that the proper volume of water has been removed from the well prior to sampling, it is first necessary to know the volume of standing water in the well pipe (including well screen where applicable). This volume can be easily calculated by the following method. Calculations shall be entered in the site legbook or field notebook or on a sample log sheet form or equivalent electronic form(s) (see SOP SA-6.3):

- 1. Obtain all available information on well construction (location, casing, screen, etc.).
- 2. Determine well or inner casing diameter.
- 3. Measure and record static water level (depth below ground level or top of casing reference point).
- 4. Determine depth of well by sounding using a clean, decontaminated, weighted tape measure or water level indicator.
- 5. Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
- 6. Calculate one static well volume in gallons $V = (0.163)(T)(r^2)$

where: V = Static volume of well in gallons.

T = Linear feet of water in the well.

r = Inside radius of well casing in inches.

O.163 = Gonversion factor (compensates for conversion of casing radius from inches to feet and cubic feet to gallons and pi.

7. Per evacuation volumes discussed above, determine the minimum amount to be evacuated before sampling.

Measuring devices may become contaminated when gathering the above information if they are submerged in contaminated water. Decontamination of the tape or water level indicator must be conducted between measurements in different wells as follows:

- 1. Saturate a paper towel or clean cotton towel with deionized water.
- 2. As the measuring device is extracted, wipe the tape, changing the cleaning surface frequently.
- After it is extracted, rinse the probe or tape using a spray bottle of deionized water over a bucket or similar collection container.

Based on the contaminant (oily, etc), it may be necessary to use a soap and water wash and rinse to remove contaminants. Isopropanel can be used on the probe/tape. However, it is recommended that the use of solvents on the tape be minimized because they could degrade the protective covering or possibly remove the scale designations. If isopropanel (or some other solvent) is used, assure that the manufacturer/supplier Material Safety Data Sheet (MSDS) is obtained, kept on site at a readily available location with other MSDSs, and reviewed by personnel prior to the first usage of the solvent. Also, add the substance to the site-specific Hazardous Chemical Inventory list (see Section 5 of the TtNUS Health and Safety Guidance Manual [HSGM], Hazard Communication Program and OSHA Standard 29 CFR 1910.1200).

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	9 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

6.4 <u>Evacuation of Static Water – Purging</u>

6.4.1 General

The amount to be purged from each well will be determined prior to sample collection. This amount will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine everall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of the aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately, the well can be pumped until parameters such as temperature, specific conductance, pH, and turbidity (as applicable) have stabilized. Onsite measurements of these parameters shall be recorded in the site logbook or field notebook or on standardized data sheets or an equivalent electronic form(s).

6.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. All of these techniques involve equipment that is portable and readily available.

Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of tubing equipped with a base plate and ball check-valve at the bottom. Bailers are comprised of stainless steel and plastic. They come in a variety of sizes, but the two most often used are 2 inches and 4 inches in diameter. An inert non-absorbent line such as polyethylene rope is used to lower and then raise the bailer to retrieve the sample. As the bailer is lowered into the water column, the ball is pushed up allowing the tube to be filled. When the bailer is pulled upward, the ball seats in the base plate preventing water from escaping.

Advantages of bailers include the following:

- There are few limitations on size and materials used.
- No external power source is needed.
- Bailers are inexpensive and can be dedicated and hung in a well to reduce the chances of crosscentamination.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Splashing the bailer into the water or transfer of sample may cause aeration.
- The use of a bailer does not permit constant in-line monitoring of groundwater parameters.
- Use of bailers is physically demanding, especially in warm temperatures at personal protection equipment (PPE) levels above Level D.

Subject GROUNDWATER SAMPLE	Number SA-1.1	Page 10 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision 7	Effective Date 04/07/2008

Safety concerns using a bailer include the following:

- Muscle stress and strain, especially when using 4-inch bailers and when pulling from excessively deep wells.
- Entanglement, possible hand/finger injuries, and rope burns during a sudden release of the bailer back down the well.
- Direct contact with contaminants of concern and sample preservatives when discharging the bailer contents because there is not a high level of control during a direct pour, and splashing and indirect contact with contaminants/preservatives could occur.

Control measures for these hazards are provided in Section 6.6.2.

Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, and peristaltic pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze flexible tubing to create suction. This tubing can be dedicated to a well to prevent cross-contamination from well to well. Suction pumps are all portable, inexpensive, and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause loss of dissolved gases and volatile organics. Another limitation of these pumps is that they require a secondary energy source to drive them. Electrically driven pumps may require portable generators as energy sources. Air diaphragm pumps require air compressors and/or compressed gas cylinders to drive them. The advantage of the peristaltic pump is that it will operate from a portable battery source. Safety measures associated with these pumps are provided below.

Air-Lift and Gas-Lift Samplers

This group of pump samplers uses gas pressure either in the annulus of the well or in a venturi to force groundwater up a sampling tube. These pumps are also relatively inexpensive. Air- or gas-lift samplers are more suitable for well development than for sampling because the samples may be aerated as a result of pump action. Aeration can cause pH changes and subsequent trace metal precipitation or loss of volatile organics.

Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. Operation principles vary, and displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch-diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include the following:

- They may have low delivery rates.
- Many models are expensive.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	11 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding of the impellers with some of these pumps.
- Decontamination of internal components can be difficult and time consuming.

Compressed Gases

Safety concerns using compressed gases as an energy source in these pumps are numerous. The nitrogen gas or compressed air is provided in a compressed gas cylinder at a pressure of approximately 2,000 psi. If damaged, these cylinders can become dangerous projectiles. Additionally, a sudden release of a cylinder's contents can involve considerable force that could cause significant damage to the eyes and/or skin. Protective measures include the following:

- Always wear safety impact glasses when handling compressed gases.
- Always administer compressed gases through an appropriate pressure-reducing regulator.
- When clearing the cylinder connection port, open the cylinder valve only enough to clear foreign
 debris. During this process, always position the cylinder valve so that it faces away from you and
 others.
- If the cylinder is designed to accept a valve protection cap, always keep that protection cap in place, except the cylinder is connected for use.
- When using the cylinder, lay the cylinder on its side to avoid the potential of it falling and knocking the valve off (and becoming a missile).
- DO NOT use the compressed nitrogen or air to clean clothing or to spray off the skin. Small cuts in the
 protective layer of the skin may permit the gas to enter into the bloodstream, presenting the potential
 danger of an embolism.

See the project-specific HASP for additional direction concerning cylinder safe handling procedures pertaining to the safe handling, transportation, and storage of compressed gas cylinders.

Electrical Shock

Even in situations where portable batteries are used, the potential for electrical shock exists. This potential risk is increased in groundwater sampling activities because of the presence of groundwater near the batteries. This potential is also increased in (prohibited) situations where jury-rigging of electrical connections is performed. Other potential hazards occur when field samplers open the hood of a running car to access the battery as a power source. To control these hazards:

- If you are unfamiliar with electrical devices, do not experiment, get help, and get the proper equipment necessary to power your device.
- Use the proper portable power inverters for cigarette lighter connections to minimize the need to access the battery under the hood of your vehicle.
- Use of electrical generators may pose a number of hazards including noise, those associated with fueling, and indirect sample influence.

019611/P Tetra Tech NUS, Inc.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	12 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

To minimize or eliminate electrical generator hazards:

- Inspect the generator before use. Ensure that the generator and any extension cords are rated for the intended operation and have a Ground Fault Circuit Interrupter (GFCI) in line to control potential electrical shock.
- Fuel the generator before purging and sampling to avoid loss of power during sampling.
- Fuel engines only when they are turned OFF and have cooled sufficiently to prevent a fire hazard.
- Place the generator and any fuel source at least 50 feet from the well to be sampled to avoid indirect influence to the sample from fuel vapors or emission gases.

Lifting Hazards

This hazard may be experienced when moving containers of purge water, equipment, cylinders, etc. To control these potential hazards:

- Do not fill purge buckets to more than 80 percent of their capacity.
- Obtain a gas cylinder of sufficient size to complete the designated task but not too large to handle. Ksize cylinders weigh approximately 135 pounds and are difficult to handle. M-size cylinders weigh approximately 50 pounds and are easier to handle and move.
- When necessary, get help lifting and moving gas cylinders and other heavy objects. Minimize twisting
 and turning while lifting. If it is necessary to move these cylinders or generators over significant
 distance, use mechanical means (carts, etc.).
- Use proper lifting techniques as described in Section 4.4 of the HSGM.

6.5 Onsite Water Quality Testing

This section describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- Ha •
- Specific conductance
- Temperature
- DO
- ORP
- Turbidity
- Salinity

This section is applicable for use in an onsite groundwater quality monitoring program to be conducted at a hazardous or nonhazardous waste site. The procedures and equipment described are applicable to groundwater samples and are not, in general, subject to solution interferences from color, turbidity, or colloidal material or other suspended matter.

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Because instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use. Most meters

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	13 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

used to measure field parameters require calibration on a daily basis. Refer to SOP SA-6.3 for an example equipment calibration log.

6.5.1 Measurement of pH

6.5.1.1 General

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken and recorded on the groundwater sample log sheet (Attachment B) or equivalent electronic form.

Two methods are given for pH measurement: the pH meter and pH indicator paper. Indicator paper is used when only an approximation of the pH is required or when pH meter readings need to be verified, and the pH meter is used when a more accurate measurement is needed. The response of a pH meter can be affected by high levels of colloidal or suspended solids, but the effect is generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, or colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

6.5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution created by the addition of the water sample reacting with the indicator compound on the paper. Various types of pH papers are available, including litmus (for general acidity or alkalinity determination) and specific, or narrower range, pH range paper.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to (in this instance, hydrogen) ion activity (which is usually similar to concentration) across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to the ion concentration is generated and measured.

6.5.1.3 Equipment

The following equipment is to be used for obtaining pH measurements:

- A stand-alone portable pH meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Combination electrode with polymer body to fit the above meter. Alternately, a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs.
- Buffer solutions, as specified by the manufacturer. If the buffer solutions are considered hazardous per 29 Code of Federal Regulations (CFR) 1910.1200 (Hazard Communication) or the volumes used are greater than consumer commodity levels, the SSO shall obtain MSDSs from the manufacturer for the specific buffer solutions (see Section 4 of the HSGM regarding the Hazard Communication Program)

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	14 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision 7	Effective Date 04/07/2008

- pH indicator paper to cover the pH range 2 through 12.
- Manufacturer's operation manual. All personnel must be familiar with the equipment operation to
 ensure that the integrity of samples is preserved and that the equipment is operated safely.

6.5.1.4 Measurement Techniques for Field Determination of pH

pH Meter

The following procedure shall be used for measuring pH with a pH meter (meter standardization is according to manufacturer's instructions):

- 1. Inspect the instrument and batteries prior to initiation of the field effort.
- 2. Check the integrity of the buffer solutions used for field calibration. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
- 3. If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- 4. Calibrate the meter and electrode(s) on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on a water quality meter calibration log sheet (Attachment C) or equivalent electronic form.
- 5. Immerse the electrode(s) in the sample. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. The failure of the measurements to stabilize must be clearly noted in the logbook or equivalent electronic form.
- 6. Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH standard unit. Also record the sample temperature (unless otherwise specified in the SAP, record temperatures to the nearest whole degree Fahrenheit or 0.5 degree Celsius).
- 7. Rinse the electrode(s) with deionized water.
- 8. Store the electrode(s) in an accordance with manufacturer's instructions when not in use.

Any visual observation of conditions that may interfere with pH measurement, such as oily materials or turbidity, shall be noted and avoided as much as possible.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is determined. To measure the pH with pH paper:

1. Collect a small portion of sample into a clean container.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	15 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- 2. Dip the pH paper into this small portion of sample.
- 3. Compare the color of the paper to the color chart that is provided with the pH paper and read the corresponding pH from the chart.
- 4. Record the pH value from the chart on the sampling log sheet.
- 5. Discard the used pH paper as trash.
- 6. Discard the small volume of sample that was used for the pH measurement with the other investigative derived waste.

6.5.2 Measurement of Specific Conductance

6.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample because temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect specific conductance. Most conductivity meters in use today display specific conductance in units of mS/cm, which is the conductivity normalized to a temperature of 25°C. These are the required units to be recorded on the groundwater sample log field form or equivalent electronic form.

6.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, and the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases, and salts such as hydrochloric acid, sodium carbonate, and sodium chloride, respectively, are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on the ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell, which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	16 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision _	Effective Date
WATER QUALITY TESTING	7	04/07/2008

6.5.2.3 Equipment

The following equipment is needed for taking specific conductance measurements:

- Stand-alone portable conductivity meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available that may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirements of the sampling program.

6.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are as follows (calibration shall be conducted according to manufacturer's instructions):

- 1. Check batteries and calibrate instrument before going into the field.
- 2. Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used for calibration.
- 3. Rinse the cell with one or more portions of the sample to be tested or with deionized water and shake excess water from the cell.
- 4. Immerse the electrode in the sample and measure the conductivity.
- 5. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
- 6. Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for troubleshooting assistance.

6.5.3 Measurement of Temperature

6.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in situ, or as quickly as possible in the field because collected water samples may rapidly equilibrate with the temperature of their surroundings.

Subject GROUNDWATER SAMPLE	Number SA-1.1	Page 17 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision 7	Effective Date 04/07/2008

6.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury-filled, dial-type thermometers or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22). In addition, various meters such as specific conductance or DO meters that have temperature measurement capabilities may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

6.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample, use the following procedure:

- 1. Immerse the thermometer in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples that will undergo subsequent chemical analysis.
- 2. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

If a temperature meter or probe is used:

- 1. Calibrate the instrument according to manufacturer's recommendations prior to use.
- 2. Immerse the meter/probe in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the meter/probe shall not be inserted into samples that will undergo subsequent chemical analysis.
- 3. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

6.5.4 Measurement of Dissolved Oxygen

6.5.4.1 General

DO levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. In addition, the growth of many aquatic organisms and the rate of corrosivity are dependent on DO concentrations. Thus, analysis for DO is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in situ because concentrations may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of DO meters. Chemical methods of analysis (i.e., Winkler methods) are available but require more equipment and greater sample manipulation. Furthermore, DO meters using a membrane electrode are suitable for highly polluted waters because the probe is completely submersible and is not susceptible to interference caused by color, turbidity, or colloidal material or suspended matter.

6.5.4.2 Principles of Equipment Operation

DO probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	18 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

the two metals, reduction of oxygen to hydroxide ion (OH-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode. This rate is proportional to the oxygen concentration in the water being measured.

Because the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, leaving the surface of the solution undisturbed.

DO probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases such as chlorine or with gases such as hydrogen sulfide that are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field logbook and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer. This compensation can counteract some of the temperature effects but not all of them.

6.5.4.3 Equipment

The following equipment is needed to measure DO concentrations:

- A stand-alone portable DO meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Sufficient cable to allow the probe to contact the sample.
- Manufacturer's operation manual.

6.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

DO probes differ as to instructions for use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure DO concentrations:

- 1. Check the DO meter batteries before going to the field.
- 2. Condition the probe in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
- Calibrate the instrument in the field according to manufacturer's recommendations or in a freshly airsaturated water sample of known temperature.
- Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
- 5. Rinse the probe with deionized water.
- 6. Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells may be moved up and down to achieve the required mixing.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	19 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- 7. Record the DO content and temperature of the sample in a field logbook or on a sample log sheet or equivalent electronic form.
- 8. Rinse the probe with deionized water.
- 9. Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable because sample handling is not involved. This however may not always be practical.

Special care shall be taken during sample collection to avoid turbulence that can lead to increased oxygen solubilization and positive test interferences.

6.5.5 Measurement of Oxidation-Reduction Potential

6.5.5.1 General

ORP provides a measure of the tendency of organic or inorganic chemicals to exist in an exidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of reduced to exidized species in the sample.

6.5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to exidize or reduce species in solution may be determined. Supplemental measurements, such as DO, may be correlated with ORP to provide knowledge of the quality of the solution, water, or wastewater.

6.5.5.3 Equipment

The following equipment is needed for measuring the ORP of a solution:

- A combination meter with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring ORP:

1. Check the equipment using the manufacturer's recommended reference solution and check its batteries before going to the field.

019611/P Tetra Tech NUS, Inc.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	20 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- 2. Thoroughly rinse the electrode with deionized water.
- 3. If the probe does not respond properly to the recommended reference solution, verify the sensitivity of the electrodes by noting the change in millivolts when the pH of a test solution is altered. The ORP will increase when the pH of a test solution decreases, and the ORP will decrease when the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note that the ORP drops sharply when the caustic is added (i.e., pH increases) thus indicating that the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions or the probe should be replaced.
- Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.

6.5.6 Measurement of Salinity

6.5.6.1 General

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Most field meters determine salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent).

6.5.6.2 Principles of Equipment Operation

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (such as are found in Standard Methods for the Examination of Water and Wastewater). Depending on the meter, the results are displayed in either ppt or percent. The salinity measurements are carried out in reference to the conductivity of standard seawater (corrected to salinity = 35 ppt).

6.5.6.3 Equipment

The following equipment is needed for salinity measurements:

- A multi-parameter water quality meter capable of measuring conductivity and temperature and converting them to salinity (e.g., Horiba U-22 or YSI 600 series).
- Calibration solution as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.6.4 Measurement Techniques for Salinity

The steps involved in taking salinity measurements are as follows (standardization shall be conducted according to manufacturer's instructions):

- 1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
- 2. Check batteries and calibrate the meter before going into the field.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	21 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- 3. Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
- 4. Rinse the cell with the sample to be tested. This is typically accomplished as the probe is placed in line during the collection of the purge water up to the time of sample acquisition.
- 5. Immerse the multi-probe in the sample and measure the salinity. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
- 6. Rinse the probes with deionized water.

6.5.7 Measurement of Turbidity

6.5.7.1 General

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter such as clay, silt, or other finely divided organic and inorganic matter and microscopic organisms including plankton.

It is important to obtain a turbidity reading immediately after taking a sample because irreversible changes in turbidity may occur if the sample is stored too long.

6.5.7.2 Principles of Equipment Operation

Turbidity is measured by the Nephelometric Method, which is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidimeter. Therefore, nephelometric turbidity units (NTUs) based on the formazin preparation will approximate units derived from the candle turbidimeter but will not be identical to them.

6.5.7.3 Equipment

The following equipment is needed for turbidity measurements:

- A turbidity meter (e.g., LaMotte 2020) that calibrates easily using test cells with standards of 0.0, 1.0, and 10 NTUs, or a combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution and sample tubes, as specified by the manufacturer.
- Manufacturer's operation manual.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	22 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

6.5.7.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements utilizing an electrode (e) or light meter (l) are listed below (standardization shall be done according to manufacturer's instructions):

- 1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
- 2. Check batteries and calibrate the instrument before going into the field.
- 3. Calibrate on a daily basis according to the manufacturer's instructions, and record all pertinent information on a turbidity meter calibration log sheet (Attachment C) or equivalent electronic form.
- 4. When using the YSI and/or Horiba U-22, rinse the electrode with one or more portions of the sample to be tested or with deionized water.
- 5. When using the Lamotte 2020, fill the light meter's glass test cell with approximately 5 mL of sample, screw on the cap, wipe off glass to remove all residue that could intercept the instrument's light beam, place the test cell in the light meter, and close the lid.
- 6. Immerse the electrode in the sample and measure the turbidity.
- 7. The reading must be taken immediately because suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
- 8. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
- 9. Rinse the electrode or test cell with deionized water.

6.6 Sampling

6.6.1 Sampling Plan

The sampling approach consisting of the following shall be developed as part of the project planning documents approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
- Intended number, sequence, volumes, and types of samples. If the relative degree of contamination between wells is insignificant, a sampling sequence that facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells. In situations where the well is not well-characterized and the nature or extent of airborne contamination is unknown, it is recommended that head space analysis using a photoionization detector (PID) or flame ionization detector (FID) is performed to rate the wells, sampling from least contaminated to most contaminated.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	23 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision	Effective Date 04/07/2008

Refer to the project-specific HASP for appropriate information and direction on air monitoring requirements.

- Sample preservation requirements.
- Work schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirements for split samples, access problems, location of keys, etc.
- The FOL shall ensure that the sampling method(s) to be employed is accurately represented in the HASP, indicating the types of sampling to be employed and the hazards. If the methods are not accurately represented, the FOL should rectify this with the HASP author.
- The FOL shall ensure that sampling teams understand the sampling approach that they are to follow. Where sampling teams are made up of personnel from multiple locations, personal sampling experiences may vary. Therefore the FOL shall review project-specific requirements, SOPs, and protocol to be followed. The FOL will conduct periodic surveys to ensure that these methods are being completed per his/her direction.

6.6.2 Sampling Methods as Related to Low-Flow Sampling

The collection of a groundwater sample consists of the following steps:

- 1. Ensure the safety of the sample location. Take a few minutes to evaluate the area for physical hazards (trip hazards, uneven ground, everhanging branches, etc.) and natural hazards (snakes, bees, spiders, etc.) that may exist in the area or that may have constructed nests in the well head. Snakes often like to sun themselves on concrete well pads. Follow provisions in the project-specific HASP and/or HSGM for addressing natural hazards.
- 2. As indicated earlier, some monitoring wells have the potential to contain pressurized headspace (e.g., through the generation of gases form contaminated groundwater, due to biological processes, degradation of contaminants, or simply based on location such as near a landfill or in areas that intersect lithological abnormalities) or through intentional artificial means such as those associated with air sparging systems. Injection or extraction wells may be artificially pressurized and may remain so for several days after the system has been turned off. This presents a hazard to people opening these wells. The Field Sampling Technician shall employ the following practices to minimize these hazards:
 - Wear safety glasses to protect the eyes. If site-specific observations and conditions indicate that the wells may be pressurized, wear a full-face shield over the safety impact eye protection.
 - DO NOT place your face or any other part of your body over the well when opening because this may place you in a strike zone.
 - Open the well cover at arms length, then step away and allow the well to off gas and stabilize.

Follow directions provided in the project-specific HASP, Work Plan and/or Sampling Plan pertaining to the use of volatile chemical detection equipment (PID or FID) within the breathing zone of the sampler

019611/P Tetra Tech NUS, Inc.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	24 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

during sampling to determine the need to retreat from the work area and/or for the use of respiratory protection (as specified in the HASP).

- 3. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet or equivalent electronic form; then calculate the fluid volume in the well pipe (as previously described in this SOP). It is imperative that downhole equipment be adequately decontaminated between wells to prevent cross-contamination. Just as sampling occurs from the least contaminated to the most contaminated, it is also recommended that groundwater level measurements be taken in this manner.
- 4. Calculate volume of well water to be removed as described in Section 6.3.
- 5. Select the appropriate purging equipment (see Attachment A to this SOP) or as designated within your Work Plan/Sampling Plan. If an electric submersible pump with packer is chosen, go to Step 10.
- 6. Lower the purging equipment or intake into the well to a short distance below the water level or mid-screen as indicated in project-specific documentation and begin water removal. Remember that some contaminants are "bottom dwellers," and in these cases, project-specific direction may specify placing the intake just above (1 to 2 feet) the well bottom. Secure the pump intake at the well and secure the effluent at the collection container and begin pumping. The pumping rate will be determined based on the decrease in the water level (see Section 6.7) or as directed in your project-specific documents or this SOP. Purge water is generally collected in a 5-gallon bucket or similar open- or closed-top container. To minimize the potential for spills and back injuries, do not fill 5-gallon buckets beyond approximately 80 percent of their capacity. Dispose of purge water was as indicated in the planning document(s). Where necessary, slow the pumping rate or lower the pump intake as required to maintain submergence.
- 7. Estimate the approximate rate of discharge frequently and record it on the Low Flow Purge Data Sheet (see Attachment D). Estimate flow rate by noting the amount of discharge in a bucket or graduated cylinder per unit time using a watch with a second hand or a stopwatch.
- 8. Observe the peristaltic pump tubing intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.
- 9. Purge a minimum of three to five easing volumes before sampling (or as directed by the site-specific SAP). In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Allow the well to recover to 75 percent of initial water level before sampling. Do not overfill purge containers because this increases the potential for spills and lifting injuries.
- 10. If sampling using a submersible pump, lower the pump intake to mid-screen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.
- 11. For pump and packer assemblies only: Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.
- 12. If the recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record this

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	25 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

occurrence in the site logbook or equivalent electronic form. When this occurs, contact the analytical laboratory to alert them that a reduced sample volume(s) will be submitted for analysis.

- 13. Fill sample containers and preserve and label them as described in SOP SA-6.1. Many sample bottles will contain preservative when they are shipped to the field. In those cases, do not add preservative.
- 14. Replace the well cap and lock it as appropriate. Make sure the well is readily identifiable as the source of the sample.
- 15. Process sample containers as described in SOP SA-6.1.
- 16. Decontaminate equipment as described in SOP SA-7.1.

6.7 <u>Low-Flow Purging and Sampling</u>

6.7.1 Scope and Application

Low-flow purging and sampling techniques may be required for groundwater sampling activities. The purpose of low-flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at or near natural flow conditions. This minimum-stress procedure emphasizes negligible water level drawdown and low pumping rates to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 1 inch or more and a saturated screen length, or open interval, of 10 feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semivolatile organic compounds, pesticides, polychlorinated biphenyls [PCBs], metals and other inorganic ions [cyanide, chloride, sulfate, etc.]). This low-flow procedure is not designed for collection of non-aqueous phase liquid samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

This procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 10 NTUs and to achieve a water level drawdown of less than 0.3 foot during purging and sampling. If these goals cannot be achieved, sample collection can take place provided that the remaining criteria in this procedure are met.

6.7.2 Equipment

The following equipment is required (as applicable) for low-flow purging and sampling:

- Adjustable rate submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom-filling bailers to be used to check for and obtain samples of LNAPLs or DNAPLs.
- Tubing Teflon, Teflon-lined polyethylene, polyethylene, polyvinyl chloride (PVC), Tygon, or stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device with 0.01-foot accuracy (electronic devices are preferred for tracking water level drawdown during all pumping operations).

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	26 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- Interface probe.
- Flow measurement supplies.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments pH, turbidity, specific conductance, and temperature.
 Use of a flow-through cell is recommended. Optional indicators ORP, salinity, and DO. A flow-through cell (also referred to as an in-line sample chamber) is required.
- Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s) and other forms (see Attachments B through D) or equivalent electronic form(s).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event (if available).
- Field Sampling Plan.
- PID or FID instrument for measuring volatile organic compounds (VOCs) per the HASP.

6.7.3 Purging and Sampling Procedure

- 1. Open the monitoring well as stated earlier and step away. Prepare sampling equipment while allowing 3 to 5 minutes to allow the water level to reach equilibrium. In situations where VOCs are the primary contaminants of concern, air monitoring of the samplers' breathing zone areas may be required by the HASP (typically with a PID or FID).
- 2 Measure the water level immediately prior to placing the pump in the well and record the water level on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well.
- 3. Lower the measuring device further into the well to collect the total depth measurement. Again wait 3 to 5 minutes to allow the well to equilibrate to the initial water level prior to placing the pump or pump intake in the well.
- 4. Record the total well depth on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well
- 5. Lower the pump or tubing slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible, keep the pump intake at least 2 feet above the bottom of the well to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity free water samples may be difficult if there is 3 feet or less of standing water in the well.

019611/P Tetra Tech NUS. Inc.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	27 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

- 6. Start with the initial pump rate set at approximately 0.1 liter per minute. Use a graduated cylinder and stopwatch to measure the pumping rate. Adjust the pumping rates as necessary to prevent drawdown from exceeding 0.3 foot during purging. If no drawdown is noted, the pump rate may be increased (to a maximum of 0.4 liter per minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs after all other field parameters have stabilized. If groundwater is drawn down below the top of the well screen, purging shall cease or the well shall be pumped to dryness and then allowed to recover before purging continues. Well recovery to 75 percent is necessary prior to sampling. Slow-recovering wells should be identified and purged at the beginning of the workday to maximize field work efficiency. If possible, samples should be collected from these wells within the same workday and no later than 24 hours after the end of purging.
- 7. Measure the water level in the well every 5 to 10 minutes using the water level meter. Record the well water level on the Low Flow Purge Data Form (Attachment D) or equivalent electronic form.
- 8. Record on the Low Flow Purge Data Form every 5 to 10 minutes the water quality parameters (pH, specific conductance, temperature, turbidity, ORP, DO, and salinity or as specified by the approved site-specific planning document) measured by the water quality meter and turbidity meter. If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled/deionized water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form or equivalent electronic form.
- 9. Estimate the flow rate by noting the amount of discharge in a graduated cylinder per unit time using a watch with a second hand. Remeasure the flow rate any time the pump rate is adjusted and periodically during purging. This will determine if a reduction in rate has occurred due to possible battery depletion.
- 10. During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles is an indication that connections are not tight. If bubbles are observed, check for loose connections and tighten, repair, or replace them as necessary to achieve a tight connection.
- 11. Wait until stabilization is achieved, or a minimum of two saturated screen volumes have been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits, then begin sampling:
 - pH ±0.2 standard units
 - Specific conductance ±10%
 - Temperature ±10%
 - Turbidity less than 10 NTUs
 - DO ±10%
- 12. If the above conditions have not been met after the well has been purged for 4 hours, purging will be considered complete and sampling can begin. Record the final well stabilization parameters from the Low-Flow Purge Data Form onto the Groundwater Sample Log Form or equivalent electronic form.

NOTE: VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

13. If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples:

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	28 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision 7	Effective Date 04/07/2008
	/	04/01/2000

- Collect samples for non-VOC analyses first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample for VOCs, and record the new flow rate.
- Reduce the diameter of the existing tubing until the water column fills the tubing either by adding a
 connector (Teflon or stainless steel) or clamp, which should reduce the flow rate by constricting
 the end of the tubing. Proceed with sample collection.
- Insert a narrow-diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, then collect the sample from the narrow diameter tubing.
- Prepare samples for shipping as per SOP SA-6.1.

7.0 REFERENCES

American Public Health Association, 1989. <u>Standard Methods for the Examination of Water and Wastewater</u>, 17th Edition, APHA, Washington, D.C.

Barcelona, M. J., J. P. Gibb and R. A. Miller, 1983. <u>A Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling.</u> ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

Johnson Division, UOP, Inc. 1975. <u>Ground Water and Wells, A Reference Book for the Water Well Industry.</u> Johnson Division, UOP, Inc., Saint Paul, Minnesota.

Nielsen, D. M. and G. L. Yeates, 1985. <u>A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells.</u> Ground Water Monitoring Review 5:83-98.

Scalf, M. R., J. F. McNabb, W. J. Dunlap, R. L. Crosby and J. Fryberger, 1981. <u>Manual of Ground Water Sampling Procedures.</u> R. S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. EPA, Ada, Oklahoma.

- U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.
- U.S. EPA, 1980. <u>Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities.</u> Office of Solid Waste, United States Environmental Protection Agency, Washington, D.C.
- U.S. EPA, 1994. <u>Groundwater Sampling Procedure Low Flow Purge and Sampling (Draft Final).</u> U.S. Environmental Protection Agency, Region I.
- U.S. Geological Survey, 1984. <u>National Handbook of Recommended Methods for Water Data Acquisition.</u> Chapter 5: Chemical and Physical Quality of Water and Sediment. U.S. Department of the Interior, Reston, Virginia.

Subject	Number	Page
GROUNDWATER SAMPLE	SA-1.1	29 of 34
ACQUISITION AND ONSITE	Revision	Effective Date
WATER QUALITY TESTING	7	04/07/2008

ATTACHMENT A PURGING EQUIPMENT SELECTION

Diame	eter Casing	Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level 25 feet	X	Х	Х	Х	Х			
	Water Level >25 feet	Х			Х				
2-Inch	Water level <25 feet	Х	Х	Х	х	x /	х		
	Water Level >25 feet	Х			Х		х		
4-Inch	Water level <25 feet	X	Х	Х	Х	/ x	Х	X	×
	Water Level >25 feet	X			X /		х	х	×
6-Inch	Water level <25 feet				×	Х		х	X
÷	Water Level >25 feet				X			х	X
8-Inch	Water level <25 feet				X	Х		х	X
-	Water Level >25 feet				Х			X	X

Tetra Tech NUS, Inc.

ATTACHMENT A PURGING EQUIPMENT SELECTION

PAGE 2

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/L ength (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
BarCad Systems, inc.	BarCad Sampler	Dedicated; gas drive (positive displacement)	1.5/16	PE, brass, nylon, aluminum oxide	0-150 with std. tubing	1 liter for each 10-15 feet of submergence	\$220-350	Requires compressed gas; custom sizes and materials available; acts as piezometer.
Cole-Parmer Inst. Co.	Master Flex 7570 Portable Sampling Pump		<1.0/NA	(not submersible) Tygon®, silicone Viton®	0-30	with 7015- 20 pump head	\$500-600	AC/DC; variable speed control available, other models may have different flow rates.
ECO Pump Corp.	SAMPLifler	Portable; venturi	<1.5 or <2.0/NA	PP, PE, PVC, SS, Teflon®, Tefzel®	0-100	0-500 mL/min depending on lift		AC, DC, or gasoline-driven motors available; must be primed.
Geltek Corp.	Bailer 219-4	Portable; grab (positive displacement)	1.66/38	Teflon®	No limit	1,075 mL	\$120-135	Other sizes available.
GeoEngineering, Inc.	GEO-MONITOR	Dedicated; gas drive (positive displacement)	1.5/16	PE, PP, PVC, Viton®	Probably 0-150	Approximately 1 liter for each 10 feet of submergence	\$185	Acts as piezometer, requires compressed gas.
Industrial and Environmental Analysts, Inc. (IEA)	Aquarius	Portable; bladder (positive displacement)	1.75/43	SS, Teflon®, Viton®	0-250	0-2,800 mL/min	\$1,500- 3,000	Requires compressed gas; other models available; AC, DC, manual operation possible.
IEA	Syringe Sampler	Portable; grab (positive displacement)	1.75/43	SS, Teflon®	No limit	850 mL sample volume	\$1,100	Requires vacuum and/or pressure from hand pump.
Instrument Specialties Co. (ISCO)	Model 2600 Well Sampler	Portable; bladder (positive displacement)	1.75/50	PC, silicone, Teflone, PP, PE, Detrine, acetal	0-150	0-7,500 mDmin	\$990	Requires compressed gas (40 psi minimum).
Keck Geophysical Instruments, Inc.	SP-81 Submersible Sampling Pump	Portable; helical rotor (positive displacement)	1.75/25	SS, Teffon®, PP, EPDM, Viton®	0-160	0-4,500 mL/min	\$3,500	DC operated.
Leonard Mold and Die Works, Inc.	GeoFilter Small Diameter Well Pump (#0500)	Portable; bladder (positive displacement)	1.75/38	SS, Teflon®, PC, Neoprene®	0-400	0-3,500 mL/min	\$1,400- 1,500	Requires compressed gas (55 psi minimum); pneumatic or AC/DC control module.
Oil Recovery Systems, Inc.	Surface Sampler	Portable; grab (positive displacement)	1.75/12	acrylic, Detrin®	No limit	Approximately 250 mL	\$125-160	Other materials and models available; for measuring thickness of "floating" contaminants.
Q.E.D. Environmental Systems, Inc.	Well Wizard® Monitoring System (P-100)	Dedicated; bladder (positive displacement)	1.66/36	PVC	0-230	0-2,000 mL/min	\$300-400	Requires compressed gas; piezometric level indicator; other materials available.

Subject

GROUNDWATER SAMPLE ACQUISITION AND ONSITE WATER QUALITY TESTING

Revision

Effective Date 04/07/2008

30 of 34

Number

SA-1.1

ATTACHMENT A

PURGING EQUIPMENT SELECTION

PAGE 3

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/L	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
			ength (Inches)					
Randolph Austin Co.	Model 500 Vari-Flow Pump	Portable; peristaltic (suction)	<0.5/NA	(Not submersible) Rubber, Tygon®, or Neoprene®	0-30	See comments	\$1,200- 1,300	Flow rate dependent on motor and tubing selected; AC operated; other models available.
Robert Bennett Co.	Model 180	Portable; piston (positive displacement)	1.8/22	SS, Teflon®, Delrin® PP, Viton®, acrylic, PE	0-500	0-1,800 mL/min	\$2,600- 2,700	Requires compressed gas; water level indicator and flow meter; custom models available.
Slope Indicator Co. (SINCO)	Model 514124 Pneumatic Water Sampler	Portable; gas drive (positive displacement)	1.9/18	PVC, nylon	0-1,100	250 mL/flushing cycle	\$250-350	Requires compressed gas; SS available; piezometer model available; dedicated model available.
Solinst Canada Ltd.	5W Water Sampler	Portable; grab (positive displacement)	1.9/27	PVC, brass, nylon, Neoprene®	0-330	500 mL	\$1,300- 1,800	Requires compressed gas; custom models available.
TIMCO Mfg. Co., Inc.	Std. Bailer	Portable; grab (positive displacement)	1.66/Custo m	PVC, PP	No limit	250 mL/ft of bailer	\$20-60	Other sizes, materials, models available; optional bottom-emptying device available; no solvents used.
TIMCO	Air or Gas Lift Sampler	Portable; gas drive (positive displacement)	1.66/30	PVC, Tygon [®] , Teflon [®]	0-150	350 ml/flushing cycle	\$100-200	Requires compressed gas; other sizes, materials, models available; no solvents used.
Tole Devices Co.	Sampling Pump	Portable; bladder (positive displacement)	1.38/48	SS, silicone, Delrin [®] , Tygon [®]	0-125	0-4,000 mL/min	\$800- 1,000	Compressed gas required; DC control module; custom built.

Construction Material Abbreviations:

Other Abbreviations:

PE PP Polyethylene Polypropylene Polyvinyl chloride **PVC**

NA Not applicable Alternating current AC DC Direct current

GROUNDWATER SAMPLE ACQUISITION AND ONSITE WATER QUALITY TESTING

Revision

Effective Date 04/07/2008

31 of 34

SA-1.1

SS Stainless steel PC

Polycarbonate

EPDM Ethylene-propylene diene (synthetic rubber)

NOTE: Other manufacturers market pumping devices which could be used for groundwater sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No skimmer, scavenger-type, or high-capacity pumps are included.

Source: Barcelona et al., 1983.

Subject	0001	INDWATED CAMPLE		Nur	nber			- · · · · · · · · · · · · · · · · · · ·	Page		0.4	
		INDWATER SAMPLE	_	SA-1.1						32 of 34		
		ISITION AND ONSITE		Rev	vision		Effective Date					
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			GROUN	DWAT	ER SA	MPLE LO	G SHEE	T .				
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		Project Site Name: Project No.: [] Domestic Well Data [x] Monitoring Well Data [] Other Well Type: [] QA Sample Type:					Sample C.O.C. I Type of IXI Lov	Location: d By:	ration			
		SAMPLING DATA:	COLOR MEDICAL	Socratically				× 1836/26/16/2010				
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		Time: Method:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	mV	NA NA		
		PURGE DATA:				/		1.78		San Joseph		
		Date:	Volume	pН	S.C.	Temp. (C)	Turbidity	DO	ORP	Other		
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Subject GROUNDWATER SAMPLE	Number SA-1.1	Page 33 of 34
ACQUISITION AND ONSITE WATER QUALITY TESTING	Revision 7	Effective Date 04/07/2008

ATTACHMENT C				
EQUIPMENT CALIBRATION LOG				

Tetra Tech NUS, Inc.	EQUIPMENT CALIBRATION LOG	
PROJECT NAME :	INSTRUMENT NAME/MODEL:	
SITE NAME:	MANUFACTURER:	
PROJECT No.:	SERIAL NUMBER:	/

Date	Instrument I.D. Number	I.D. Performing Number Calibration	Instrument Settings Instrument Re		Readings	Calibration	Remarks	
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Subject	GROUNDWATE		Number SA-1.1	Page 34 of 34			
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	ATTACHMENT D LOW FLOW PURGE DATA SHEET						
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	OW PL	S. Cond.					
:	LOW FLOW PURGE DATA SHEET	Hd (6.U.)					
		Flow (mL/Min.)					
	PROJECT SITE NAME:	Water Level		RE(S):			
	PROJECT	Time (His.)		SIGNATURE(S):			



EQUIPMENT CALIBRATION LOG

PROJECT NAME :	INSTRUMENT NAME/MODEL:		
SITE NAME:	MANUFACTURER:		
PROJECT No.:	SERIAL NUMBER:		

Date	Instrument	Person	Instrumen	t Settings	Instrument	Readings	Calibration	Remarks
of	I.D.	Performing	Pre-	Post-	Pre-	Post-	Standard	and
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STANDARD OPERATING PROCEDURES

Number SA-1.2	Page 1 of 21
Effective Date 01/2012	Revision 6

Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject

SURFACE WATER AND SEDIMENT SAMPLING

Approved

J. Zimmerly

TABLE OF CONTENTS

SEC	<u>TION</u>		<u>PAGE</u>
1.0	PURPO	SE	2
2.0	SCOPE		2
3.0	GLOSS	ARY	2
4.0	RESPO	NSIBILITIES	2
5.0	HEALTH	H AND SAFETY	3
6.0	PROCE	DURES	6
	6.1 6.1.1 6.1.2 6.2 6.3 6.3.1 6.3.2	Introduction Surface Water Sampling Equipment Surface Water Sampling Techniques Onsite Water Quality Testing Sediment Sampling General Sampling Equipment and Techniques for Bottom Materials	
7.0	REFERE	ENCES	14
<u>ATT</u>	ACHMENTS	<u> </u>	
	A B C	SURFACE WATER SAMPLE LOG SHEETSOIL & SEDIMENT SAMPLE LOG SHEETGUIDANCE ON SAMPLE DESIGN AND SAMPLE COLLECTION	17

Subject	Number	Page
SURFACE WATER AND SEDIMENT SAMPLING	SA-1.2	2 of 21
	Revision	Effective Date
	6	01/2012

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures and equipment commonly used for collecting environmental samples of surface water and aquatic sediment for either onsite examination and chemical testing or for offsite laboratory analysis.

2.0 SCOPE

The information presented in this document is applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.5), except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions, and equipment different from those described herein.

3.0 GLOSSARY

Analyte - Chemical or radiochemical material whose concentration, activity, or mass is measured.

<u>Composite Sample</u> – A sample representing a physical average of grab samples.

<u>Environmental Sample</u> – A quantity of material collected in support of an environmental investigation that does not require special handling or transport considerations as detailed in SOP SA-6.1.

<u>Grab Sample</u> – A portion of material collected to represent material or conditions present at a single unit of space and time.

<u>Hazardous Waste Sample</u> – A sample containing (or suspected to contain) concentrations of contaminants that are high enough to require special handling and/or transport considerations per SOP SA-6.1.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

<u>Project Manager</u> - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of soil samples. The Project Manager also has the overall responsibility for seeing that all surface water and sediment sampling activities are properly conducted by appropriately trained personnel in accordance with applicable planning documents.

<u>Field Operations Leader</u> - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field

Subject SURFACE WATER AND	Number SA-1.2	Page 3 of 21
SEDIMENT SAMPLING	Revision 6	Effective Date 01/2012

technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface water and sediment samples. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

<u>Site Safety Officer (SSO)</u> - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP). This includes but is not be limited to performing air quality monitoring during sampling and boring and excavation activities, and ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the FOL on other safety-related matters regarding boring and sampling, such as mitigative measures to address potential hazards from hazardous objects or conditions.

<u>Project Geologist/Sampler</u> - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, , container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Precautions to preserve the health and safety of field personnel implementing this SOP are distributed throughout. The following general hazards may also exist during field activities, and the means of avoiding them must be used to preserve the health and safety of field personnel:

Bridge/Boat Sampling – Potential hazards associated with this activity include:

- Traffic one of the primary concerns as samplers move across a bridge because free space of travel is not often provided. Control measures should include:
 - When sampling from a bridge, if the samplers do not have at least 6 feet of free travel space or physical barriers separating them and the traffic patterns, the HASP will include a Traffic Control Plan.
 - The use of warning signs and high-visibility vests are required to warn oncoming traffic and to increase the visibility of sample personnel.
- Slips, trips, and falls from elevated surfaces are a primary concern. Fall protection shall be worn
 when or if samplers must lean over a rail to obtain sample material. A Fall Protection Competent
 Person (in accordance with Occupational safety and Health Administration [OSHA] fall protection
 standards) must be assigned to ensure that fall protection is appropriately and effectively employed

Subject	Number	Page
SURFACE WATER AND SEDIMENT SAMPLING	SA-1.2	4 of 21
	Revision	Effective Date
	6	01/2012

- Water hazards/drowning if someone enters the water from an elevated surface (such as a bridge or dock) and when sampling from a boat. To minimize this potential, personnel shall wear United states Coast Guard (USCG)-approved floatation devices, and the sampling crew must also have on hand a Type IV Throwable Personal Floatation Device with at least 90 feet of 3/8-inch rope. See Section 5.5.2 of this SOP.
- Within the HASP, provisions will also be provided concerning the requirement of a Safe Vessel
 Certification or the necessity to conduct a boat inspection prior to use. In addition, the HASP shall
 also specify requirements as to whether the operator must be certified as a commercial boat operator
 and whether members of the sampling team must have a state-specific safe boating certification.

Entering Water to Collect Samples – Several hazards are associated with this activity and can be mitigated as follows:

- Personnel must wear a USCG-approved Floatation Device (selected and identified in the HASP).
 The SSO shall ensure that the device selected is in acceptable condition and suitable for the individual using it. This includes consideration of the weight of the individual.
- Lifelines shall be employed from a point on the shore. This activity will always be conducted with a Buddy. See Section 6.5.2.
- Personnel shall carry a probe to monitor the bottom ahead of them for drop offs or other associated hazards.
- The person in the water shall exercise caution concerning the path traveled so that the lifeline does not become entangled in underwater obstructions such as logs, branches, stumps, etc., thereby restricting its effectiveness in extracting the person from the water.
- Personnel shall not enter waters on foot in situations where natural hazards including alligators, snakes, as well as sharks, gars, and other predators within inland waterways may exist.
- In all cases, working along and/or entering the water during high currents or flood conditions shall be prohibited.
- Personnel shall not enter bodies of water where known debris exists that could result in injuries from cuts and lacerations.

Sampling in marshes or tidal areas in some instances can be accomplished using an all-terrain vehicle (ATV). This is not the primary recommended approach because the vehicle may become disabled, or weather conditions or tidal changes could result in environmental damage as well as loss of the vehicle. The primary approach is recommended to be on foot where minimal disturbance would occur. The same precautions specified above with regard to sediment disturbance apply as well as the previously described safety concerns associated with natural hazards. The natural hazards include alligators, bees (nests in dead falls and tree trunks), snakes, etc. In addition, moving through and over this terrain is difficult and could result in muscle strain and slips, trips, and falls. Common sense dictates that the sampler selects the most open accessible route over moderate terrain. Move slowly and deliberately through challenging terrain to minimize falls. Mud boots or other supportive PPE should be considered and specified in the HASP to permit samplers to move over soft terrain with the least amount of effort. In these situations, it is also recommended, as the terrain allows, that supplies be loaded and transported in a sled over the soft ground.

Working in these areas, also recognize the following hazards and means of protection against them:

Subject	Number	Page
SURFACE WATER AND	SA-1.2	5 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

Insects are also a primary concern. These include mosquitoes, ticks, spiders, bees, ants, etc. The HASP will identify those particular to your area. Typical preventative measures include:

- Use insect repellant. Approval of various repellants should be approved by the Project Chemist or Project Manager.
- Wearing light-colored clothing to control heat load due to excessive temperatures. In addition, it
 makes it easier to detect crawling insects on your clothing.
- Taping pants to boots to deny access. Again, this is recommended to control access to the skin by crawling insects. Consultation with the Project Health and Safety Officer SSO/Health and Safety Manager is recommended under extreme heat loads because this will create conditions of heat stress.
- Performing a body check to remove insects. The quicker you remove ticks, the less likely they will become attached and transfer bacteria to your bloodstream. Have your Buddy check areas inaccessible to yourself. This includes areas such as the upper back and between shoulder blades where it is difficult for you to examine and even more difficult for you to remove.

Safety Reminder

If you are allergic to bee or ant stings, it is especially critical that you carry your doctor-recommended antidote with you in these remote sampling locations due to the extended time required to extract incapacitated individuals as well as the effort required to extract them. In these scenarios, instruct your Buddy in the proper administration of the antidote. In all cases, if you have received a sting, administer the antidote regardless of the immediate reaction, evacuate, and seek medical attention as necessary. The FOL and/or SSO will determine when and if you may return to the field based on the extent of the immune response and hazards or potential hazards identified in these locations. To the FOL and SSO, this is a serious decision you have to make as to whether to take someone vulnerable to these hazards into a remote location where you may not be able to carry them out. Consider it wisely.

Poisonous Plants – To minimize the potential of encountering poisonous plants in the field, at least one member of the field team needs to have basic knowledge of what these plants look like so that they can be recognized, pointed out to other field personnel, and avoided if at all possible. If the field team cannot avoid contact and must move through an area where these plants exist, the level of personal protective equipment (PPE) shall include Tyvek coveralls and enhanced decontamination procedures for the removal of oils from the tooling and/or equipment.

Temperature-Related Stress – Excessively cold temperatures may result in cold stress, especially when entering the water either intentionally or by accident. Provisions for combating this hazard should be maintained at the sample location during this activity. Excessively hot temperatures may result in heat stress especially in scenarios where equipment is packed through the marsh.

Because all of these activities are conducted outside, electrical storms are a significant concern. The following measures will be incorporated to minimize this hazard:

 Where possible, utilize commercial warning systems and weather alerts to detect storms moving into the area.

Subject SURFACE WATER AND	Number SA-1.2	Page 6 of 21
SEDIMENT SAMPLING	Revision 6	Effective Date 01/2012

- If on or in the water, get out of the water. Move to vehicles or preferably into enclosed buildings with plumbing and wiring.
- Where warning systems are not available, follow the 30/30 Rule (if there are less than 30 seconds between thunder and lightning, go inside for at least 30 minutes after the last thunder).

See Section 4.0 of the Health and Safety Guidance Manual (HSGM) for additional protective measures.

6.0 PROCEDURES

6.1 <u>Introduction</u>

Collecting a representative sample of surface water or sediment may be difficult because of water movement, stratification, or heterogeneous distribution of the targeted analytes. To collect representative samples, one must standardize sampling methods related to site selection, sampling frequency, sample collection, sampling devices, and sample handling, preservation, and identification. Regardless of quality control applied during laboratory analyses and subsequent scrutiny of analytical data packages, reported data are no better than the confidence that can be placed in the representativeness of the samples. Consult Appendix C for guidance on sampling that should be considered during project planning and that may be helpful to field personnel.

6.1.1 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type to be acquired. In general, the most representative samples are obtained from mid-channel at a stream depth of 0.5 foot in a well-mixed stream; however, project-specific planning documents will address site-specific sampling requirements including sample collection points and sampling equipment. The most frequently used samplers include the following:

- Peristaltic pump
- Bailer
- Dip sampler
- Weighted bottle
- Hand pump
- Kemmerer
- Depth-integrating sampler

The dip sampler and weighted bottle sampler are used most often, and detailed discussions for these devices and the Kemmerer sampler are addressed subsequently in this section.

The criteria for selecting a sampler include:

- 1. Disposability and/or easy decontamination.
- 2. Inexpensive cost (if the item is to be disposed).
- 3. Ease of operation.
- 4. Non-reactive/non-contaminating properties Teflon-coated, glass, stainless-steel or polyvinyl chloride (PVC) sample chambers are preferred (in that order).

Subject	Number	Page
SURFACE WATER AND	SA-1.2	7 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

Measurements collected for each sample (grab or each aliquot collected for compositing) shall include but not be limited to:

- Specific conductance
- Temperature
- pH
- Dissolved oxygen

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field notebook or on sample log sheets (see Attachment A) or an equivalent electronic form(s). These analyses may be selected to provide information on water mixing/stratification and potential contamination. Various types of water bodies have differing potentials for mixing and stratification.

In general, the following equipment if necessary for obtaining surface water samples:

- Required sampling equipment, which may include a remote sampling pole, weighted bottle sampler, Kemmerer sampler, or other device.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in the project-specific planning document.
- Required PPE as directed in the project-specific planning document, which may include:
 - Nitrile surgeon's or latex gloves (layered as necessary).
 - Safety glasses.
 - Other items identified on the Safe Work Permit that may be required based on location-specific requirements (e.g., hearing protection, steel-toed work boots, hard hat). These provisions will be listed in the HASP or addressed by the FOL and/or SSO.

Safety Reminder

The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

- Required paperwork (see SOP SA-6.3 and Attachments A and B to this SOP).
- Required decontamination equipment.
- Required sample containers.
- Sealable polyethylene bags (e.g., Ziploc[®] baggies).
- Heavy-duty cooler.
- Ice.
- Paper towels and garbage bags.
- Chain-of-custody records and custody seals.

Subject	Number	Page
SURFACE WATER AND	SA-1.2	8 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

Dip Sampling

Specific procedures for collecting a dip or grab sample of surface water can vary based on site-specific conditions (e.g., conditions near the shore and how closely a sampler can safely get to the shore). The general procedure for collecting a sample using a pole or directly from the water body is as follows:

- 1. If using a remote sampling pole, securely attach the appropriate sample container to a pole of sufficient length to reach the water to be sampled. Samples for volatile analysis should be collected first. Use PPE as described in the HASP. When sample containers are provided pre-preserved or if the pole cannot accommodate a particular sample container, use a dedicated, clean, unpreserved bottle/container for sampling and transfer to an appropriately preserved container.
- 2. Remove the cap. Do not place the cap on the ground or elsewhere where it might become contaminated.
- 3. Carefully dip the container into the water just below the surface (or as directed by project-specific planning documents), and allow the bottle to fill. Sample bottles for volatile analysis must be filled with no headspace. Avoid contacting the bottom of the water body because this will disturb sediment that may interfere with the surface water sample.
- 4. Retrieve the container and carefully replace the cap securely. If using a container other than the sample bottle, pour the water from that container into the sample bottle and replace the cap securely.
- 5. Use a clean paper towel to clean and dry the outside of the container.
- 6. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.
- 7. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

Constituents measured in grab samples collected near the water surface are only indicative of conditions near the surface of the water and may not be a true representation of the total concentration distributed throughout the water column and in the cross section. Therefore, as possible based on site conditions, the sampler may be required to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

CAUTION

In areas prone to natural hazards such as alligators and snakes, etc., always use a buddy as a watch. Always have and use a lifeline or throwable device to extract persons who could potentially fall into the water. Be attentive to the signs, possible mounds indicating nests, and possible slides into the water. Remember that although snakes are typically encountered on the ground, it is not unheard of to see them on low-hanging branches. Be attentive to your surroundings because these may indicate that hazards are nearby.

Weighted Bottle Sampling

A grab sample can also be collected using a weighted holder that allows a bottle to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open

Subject	Number	Page
SURFACE WATER AND	SA-1.2	9 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of glass or plastic bottle with a stopper, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The general procedure for sampling with this device is as follows:

- 1. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
- 2. When the desired depth is reached, pull out the stopper with a sharp jerk of the stopper line.
- 3. Allow the bottle to fill completely, as evidenced by the absence of air bubbles.
- 4. Raise the sampler and cap the bottle.
- 5. Use a paper towel to clean and dry the outside of the container. This bottle can be used as the sample container as long as the bottle is an approved container type.
- 6. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.
- 7. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

Kemmerer Sampler

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon-coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless steel or acrylic cylinder with rubber stoppers that leave the ends open while it is lowered in a vertical position (thus allowing free passage of water through the cylinder). A "messenger" is sent down the line when the sampler is at the designated depth to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles. The general procedure for sampling with this device is as follows:

- 1. Gently lower the sampler to the desired depth.
- 2. When the desired depth is reached, send down the messenger to close the cylinder and then raise the sampler.
- 3. Open the sampler valve to fill each sample bottle (filling bottles for volatile analysis first).
- 4. Use a paper towel to clean and dry the outside of the container.
- 5. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.
- 6. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

6.1.2 Surface Water Sampling Techniques

Samples collected during site investigations may be grab samples or composite samples. The following general procedures apply to various types of surface water collection techniques:

Subject SURFACE WATER AND	Number SA-1.2	Page 10 of 21
SEDIMENT SAMPLING	Revision 6	Effective Date 01/2012

- If a clean, pre-preserved sample container is not used, rinse the sample container least once with the
 water to be sampled before the sample is collected. This is not applicable when sample containers
 are provided pre-preserved because doing so will wash some or all of the preservative out of the
 bottle.
- For sampling moving water, collect the farthest downstream sample first, and continue sample collection in an upstream direction. In general, work from zones suspected of low contamination to zones of high contamination.
- Take care to avoid excessive agitation of the water because loss of volatile constituents could result.
- When obtaining samples in 40 mL vials with septum-lined lids for volatile organics analysis, fill the container completely (with a meniscus) to exclude any air space in the top of the bottle and to be sure that the Teflon liner of the septum faces in after the vial is filled and capped. Turn the vial upside down and tap gently on your wrist to check for air bubbles. If air bubbles rise in the bottle, add additional sample volume to the container.
- Do not sample at the surface, unless sampling specifically for a known constituent that is immiscible and on top of the water. Instead, invert the sample container, lower it to the approximate depth, and hold it at about a 45-degree angle with the mouth of the bottle facing upstream.

6.2 Onsite Water Quality Testing

Onsite water quality testing shall be conducted as described in SOP SA-1.1.

6.3 Sediment Sampling

6.3.1 General

If composite surface water samples are collected, sediment samples are usually collected at the same locations as the associated surface water samples. If only one sediment sample is to be collected, the sampling location shall be approximately at the center of the water body, in a depositional area if possible based on sample location restraints (see below), unless the SAP states otherwise.

Generally, coarser-grained sediments are deposited near the headwaters of reservoirs. Bed sediments near the center of a water body will be composed of fine-grained materials that may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathymetry (i.e., depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (e.g., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled, in general, and areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials shall be generally avoided. Follow instructions in the SAP, as applicable.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are less than detection limits). Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

Subject	Number	Page
SURFACE WATER AND	SA-1.2	11 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

Samples collected for volatile organic compound (VOC) analysis must be collected prior to any sample homogenization. Regardless of the method used for collection, the aliquot for VOC analysis must be collected directly from the sampling device (hand auger bucket, scoop, trowel), to the extent practical. If a device such as a dredge is used, the aliquot should be collected after the sample is placed in the mixing container prior to mixing.

In some cases, the sediment may be soft and not lend itself to collection by plunging Encore or syringe samplers into the sample matrix. In these cases, it is appropriate to open the sampling device, (Encore barrel or syringe) prior to sample collection, and carefully place the sediment in the device, filling it fully with the required volume of sample.

On active or former military sites, ordnance items may be encountered in some work areas. Care should be exercised when handling site media (such as if unloading a dredge as these materials may be scooped up). If suspected ordnance items are encountered, stop work immediately, move to shore and notify the Project Manager and Health and Safety Manager.

All relevant information pertaining to sediment sampling shall be documented as applicably described in SOP SA-6.3 and Attachment B or an equivalent electronic form.

6.3.2 Sampling Equipment and Techniques for Bottom Materials

A bottom-material sample may consist of a single scoop or core, or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques.

SAFETY REMINDER

The following health and safety provisions apply when working on/over/near water:

- At least two people are required to be present at the sampling location in situations where the water depth and/or movement deem it necessary, each wearing a USCG-approved Personal Flotation Devices
- A minimum of three people are required if <u>any</u> of the following conditions are anticipated or observed:
 - Work in a waterway that is turbulent <u>or</u> swift that could sweep a sampler down stream should he or she fall in accidentally.
 - The underwater walking surface (e.g., stream/river bed) is suspected or observed to involve conditions that increase the potential for a worker to fall into the water. Examples include large/uneven rocks or boulders, dense mud or sediment that could entrap worker's feet, etc.
 - Waterway is tidal, and conditions such as those listed above could rapidly change.

The third person in the above condition must be equipped and prepared to render emergency support [e.g., lifeline, tethered Personal Flotation Device (Throwable Type IV, life saver), skiff, means to contact external emergency response support, etc.]

The following samplers may be used to collect sediment samples:

Subject SURFACE WATER AND	Number SA-1.2	Page 12 of 21
SEDIMENT SAMPLING	Revision 6	Effective Date 01/2012

- Scoop sampler
- Dredge samplers
- Coring samplers

Each type of sampler is discussed below.

In general, the following equipment if necessary for obtaining sediment samples:

- Required sampling equipment, which may include a scoop sampler, dredge sampler, coring sampler, or stainless steel or pre-cleaned disposable trowel.
- Stainless bowl or pre-cleaned disposable bowl to homogenize sample.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in the project-specific planning document.
- Required PPE as directed in the project-specific planning document, which may include:
 - Nitrile surgeon's or latex gloves (layered as necessary).
 - Safety glasses.
 - Other items identified on the Safe Work Permit that may be required based on location-specific requirements (e.g., hearing protection, steel-toed work boots, hard hat). These provisions will be listed in the HASP or addressed by the FOL and/or SSO.
 - Required paperwork (see SOP SA-6.3 and Attachments A and B to this SOP).
 - Required decontamination equipment.
 - Required sample containers.
 - Sealable polyethylene bags (e.g., Ziploc® baggies).
 - Heavy-duty cooler.
 - Ice.
 - Paper towels and garbage bags.
 - Chain-of-custody records and custody seals.

Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood, PVC, or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if the sampler can safely wade to the required location, the easiest and best way to collect a sediment sample is to use a scoop sampler. Scoop sampling also reduces the potential for cross-contamination. The general scoop sampling procedure is as follows:

Subject	Number	Page
SURFACE WATER AND	SA-1.2	13 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

- 1. Reach over or wade into the water body.
- 2. While facing upstream (into the current), scoop the sampler along the bottom in an upstream direction. Although it is very difficult not to disturb fine-grained materials at the sediment-water interface when using this method, try to keep disturbances to a minimum.

Dredge Samplers

Dredges are generally used to sample sediments that cannot easily be obtained using coring devices (e.g., coarse-grained or partially cemented materials) or when large quantities of sample are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a "messenger." Some dredges are heavy and may require use of a winch and crane assembly for sample retrieval. The three major types of dredges are Peterson, Eckman and Ponar.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The Peterson dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends, thus reducing the "shock wave." The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

The general procedure for using dredge samplers is as follows:

- 1. Gently lower the dredge to the desired depth.
- When the desired depth is reached, send the messenger down to cable to close the cylinder and then carefully raise the sampler.
- 3. Open the sampler to retrieve the sediment.
- 4. Transfer the sediment to the bowl in which it will be homogenized. Fill the sample bottle(s) for volatile analysis *prior to* homogenization. Homogenize the remainder of the sediment collected.
- 5. Fill the containers for all analyses other and VOCs.
- 6. Use a paper towel to clean and dry the outside of each container.
- 7. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.

Subject	Number	Page
SURFACE WATER AND	SA-1.2	14 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

SAFETY REMINDER

Safety concerns using these dredges include lifting hazards, pinches, and compressions (several pinch points exist within the jaws and levers). In all cases, handle the dredge by the rope to avoid capturing fingers/hands.

Coring Samplers

Coring samplers are used to sample vertical columns of sediment. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand-push tubes to electronic vibrational core tube drivers.

Coring devices are particularly useful in pollutant monitoring because turbulence created by descent through the water is minimal, thus the fines at the sediment-water interface are only minimally disturbed. The sample is withdrawn intact, permitting the removal of only those layers of interest.

In shallow, wadeable waters, the use of a core liner or tube manufactured of Teflon or plastic is recommended for the collection of sediment samples. Caution should be exercised not to disturb the bottom sediments when the sample is obtained by wading in shallow water. The general procedure to collecting a sediment sample with a core tube is as follows:

- 1. Push the tube into the substrate until 4 inches or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is being pushed will facilitate greater penetration and decrease core compaction.
- 2. Cop the top of the tube to provide suction and reduce the chance of losing the sample.
- 3. Slowly extract the tube so as not to lose sediment from the bottom of the tube. Cap the bottom of the tube before removing it from the water. This will also help to minimize loss of sample.
- 4. Transfer the sediment to the bowl in which it will be homogenized. Fill the sample bottle(s) for volatile analysis prior to homogenization. Homogenize the remainder of the sediment collected.
- 5. Fill the containers for all analyses other and VOCs.
- 6. Use a paper towel to clean and dry the outside of each container.
- 7. Affix a sample label to each container, ensuring that each label is completely carefully, clearly, and completely, addressing all of the categories described in SOP SA-6.3.
- 8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.

In deeper, non-wadeable water bodies, sediment cores may be collected from a bridge or boat using different coring devices such as Ogeechee Sand Pounders, gravity cores, and vibrating coring devices. All three devices utilize a core barrel with a core liner tube system. The core liners can be removed from the core barrel and replaced with a clean core liner after each sample. Before extracting the sediment from the coring tubes, the clear supernatant above the sediment-water interface in the core should be decanted from the tube. This is accomplished by turning the core tube to its side and gently pouring the liquid out until fine sediment particles appear in the waste liquid. Post-retrieval processing of samples is the same as above.

Subject SURFACE WATER AND	Number SA-1.2	Page 15 of 21
SEDIMENT SAMPLING	Revision 6	Effective Date 01/2012

7.0 REFERENCES

American Public Health Association, 19.99 <u>Standard Methods for the Examination of Water and Wastewater</u>, 20th Edition, APHA, Washington, D.C.

Feltz, H. R., 1980. <u>Significance of Bottom Material Data in Evaluating Water Quality in Contaminants and</u> Sediments. Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., V. 1, p. 271-287.

Kittrell, F. W., 1969. <u>A Practical Guide to Water Quality Studies of Streams.</u> U.S. Federal Water Pollution Control Administration, Washington, D.C., 135 p.

U.S. EPA, 1984. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-84-017.

U.S. EPA, 2001. Environmental Investigations <u>Standard Operating Procedures and Quality Assurance</u> Manual. Water Surveillance Branch, USEPA Surveillance and Analytical Division, Athens, Georgia.

U.S. Geological Survey, 1977. <u>National Handbook of Recommended Methods for Water-Data</u> Acquisition. Office of Water Data Coordination, USGS, Reston, Virginia.

SURFACE WATER AND		Ν	lumber	SA-1.2	!		Pa	age 16	of 21
 SEDIMENT SAMPLING		F	Revision	6			Ef	fective Date 01/	2012
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Project Site Name: Project No.: [] Stream [] Spring [] Pond [] Lake [] Other: [] QA Sample Type:					Sampled C.O.C. N Type of [] Low	Location: d By: No.:			
SAMPLING DATA: Date:	Color	рН	s.c.	Temp.	Turbidity	DO	Salinity	Other	
Time: Depth: Method:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA NA	
SAMPLE COLLECTION INF Analysis	ORMATIC	N: Preser	vative		Container Re	equirements		Collected	
OBSERVATIONS / NOTES:		 		MAP:					
					Signature				

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Subject

SURFACE WATER AND SEDIMENT SAMPLING

Number SA-1.2	Page 17 of 21
Revision 6	Effective Date 01/2012

ATTACHMENT B SOIL & SEDIMENT SAMPLE LOG SHEET

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Project Site Name: Project No.: [] Surface Soil [] Subsurface Soil [] Sediment [] Other: [] QA Sample Type:				Sample ID Sample Lo Sampled E C.O.C. No Type of Sa [] Low Cc [] High C	No.: cation:	
GRAB SAMPLE DA	TA:			+ 8% 25		
Date: Time: Method: Monitor Reading (ppi	_	Depth	Color	Description	(Sand, Silt, Clay, Mo	sture, etc.)
COMPOSITE SAMP	I I		77.	Harita Kiri		
Date:	Time	Depth	Color	Description	(Sand, Silt, Clay, Mo	sture, etc.)
Method:						
Monitor Readings (Range in ppm):						
SAMPLE COLLECT	ION INFORMATI Analysis	ON:	Container Rec	quirements	Collected	Other
OBSERVATIONS / I	NOTES:			MAP:		
Circle if Applicable				Signature(s):		
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Subject	Number	Page
SURFACE WATER AND	SA-1.2	18 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

APPENDIX C GUIDANCE ON SAMPLING DESIGN AND SAMPLE COLLECTION

C.1 Defining the Sampling Program

Many factors are considered in developing a sampling program for surface water and/or sediment, including study objectives, accessibility, site topography, physical characteristics of the water body (e.g., flow and mixing), point and diffuse sources of contamination, and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on vertical and lateral mixing within the body of water. For sediment, dispersion depends on bottom current or flow characteristics, sediment characteristics (e.g., density, size), and geochemical properties (that affect adsorption/desorption). The hydrogeologist developing the sampling plan must therefore know not only the mixing characteristics of streams and lakes but must also understand the role of fluvial-sediment transport, deposition, and chemical sorption.

C.1.1 Sampling Program Objectives

The scope of the sampling program must consider the sources and potential pathways for transport of contamination to or within a surface water body. Sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., contaminated runoff). The major pathways for surface water contamination (not including airborne deposition) are overland runoff, leachate influx to the water body, direct waste disposal (solid or liquid) into the water body, and groundwater flow influx from upgradient. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) that encompasses the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the locations of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc. shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation include: (1) moving the sampling location far enough downstream to allow for adequate mixing, or (2) collecting integrated samples in a cross section. Also, non-homogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to adsorb onto particulate matter. Nitrogen, phosphorus, and heavy metals may also be transported by particulates. Samples must be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

Subject	Number	Page
SURFACE WATER AND	SA-1.2	19 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

C.1.2 Location of Sampling Stations

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and consideration of site conditions must be balanced against the costs of collection as controlled by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes, reservoirs, or larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each contaminant would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of stream flow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Stream flow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrogeologist shall explore the possibility of obtaining stream flow data by direct or indirect methods. Remember these locations are also where you may encounter natural hazards as these are areas where they hunt. Always exercise extreme caution.

C.1.3 Frequency of Sampling

The sampling frequency and objectives of the sampling event will be defined by the project planning documents. For single-event site or area characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of a contaminant between the solid and aqueous phases, it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes (i.e., consisting of repetitive, continuing measurements to define variations and trends at a given location), water samples should be collected at a pre-established and constant interval as specified in the project plans (often monthly or quarterly and during droughts and floods). Samples of bottom material should generally be collected from fresh deposits at least yearly, and preferably seasonally, during both spring and fall.

The variability in available water quality data shall be evaluated before determining the number and collection frequency of samples required to maintain an effective monitoring program.

C.2 Surface Water Sample Collection

C.2.1 Streams, Rivers, Outfalls and Drainage Features

Methods for sampling streams, rivers, outfalls, and drainage features (ditches, culverts) at a single point vary from the simplest of hand-sampling procedures to the more sophisticated multi-point sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Subject SURFACE WATER AND	Number SA-1.2	Page 20 of 21
SEDIMENT SAMPLING	Revision 6	Effective Date 01/2012

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, and discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of dissolved oxygen (DO), pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected, as directed in the project planning documents.

C.2.2 Lakes, Ponds and Reservoirs

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained. The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, measurement of DO, pH, temperature, etc. is to be conducted on each aliquot of the vertical composite and on the composite itself. In naturally formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample if a sample representative of the water column is required. These vertical composites are often collected along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline that is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer that is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several vertical composites with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality because it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in situ using sensors and automatic readout or recording devices. Single and multi-parameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, DO, some cations and anions, and light penetration.

Subject	Number	Page
SURFACE WATER AND	SA-1.2	21 of 21
SEDIMENT SAMPLING	Revision	Effective Date
	6	01/2012

C.2.3 Estuaries

Estuarine areas are, by definition, zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Knowledge of the estuary type may be necessary to determine sampling locations. Estuaries are generally categorized into one of the following three types dependent on freshwater inflow and mixing properties:

- <u>Mixed Estuary</u> characterized by the absence of a vertical halocline (gradual or no marked increase
 in salinity in the water column) and a gradual increase in salinity seaward. Typically, this type of
 estuary is shallow and is found in major freshwater sheet flow areas. Because this type of estuary is
 well mixed, sampling locations are not critical.
- <u>Salt Wedge Estuary</u> characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally back and forth with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.
- Oceanic Estuary characterized by salinities approaching full-strength oceanic waters. Seasonally, freshwater inflow is small, with the preponderance of the fresh-saline water mixing occurring near or at the shore line.

Sampling in estuarine areas is normally based on the tidal phase, with samples collected on successive slack tides (i.e., when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1- to 5-foot increments, coupled with vertical DO and temperature profiles.



STANDARD OPERATING PROCEDURES

Number SA-1.3	Page 1 of 31
Effective Date 04/072008	Revision 9

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Subject

SOIL SAMPLING

Approved

Tom Johnston

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TABLE OF CONTENTS

SECT	<u>FION</u>	<u>PAGE</u>
1.0	PURPOSE	2
2.0	SCOPE	2
3.0	GLOSSARY	2
4.0	RESPONSIBILITIES AND PERSONNEL QUALIFICATION	NS3
5.0	HEALTH AND SAFETY	4
6.0	PROCEDURES	5
	6.1 Overview	
7.0	REFERENCES	26
ATTA	ACHMENTS	
	A SOIL & SEDIMENT SAMPLE LOG SHEET B SPLIT-SPOON SAMPLER	29
	C TEST PIT LOG D REMOTE SAMPLE HOLDER FOR TEST PIT/TI	

Subject	Number	Page
	SA-1.3	2 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used to collect surface, near-surface, and subsurface soil samples. Additionally, it describes the methods for sampling of test pits and trenches to determine subsurface soil and rock conditions and for recovery of small-volume or bulk samples from pits.

2.0 SCOPE

This document applies to the collection of surface, near-surface, and subsurface soil samples exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites for laboratory testing, onsite visual examination, and onsite testing.

3.0 GLOSSARY

<u>Composite Sample</u> - A composite sample is a combination of more than one grab sample from various locations and/or depths and times that is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples shall not be collected for volatile organics analysis.

Confined Space - As stipulated in 29 Code of Federal Regulations (CFR) 1910.146, a confined space means a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and (3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

<u>Grab Sample</u> - One sample collected at one location and at one specific time.

Hand Auger - A sampling device used to extract soil from the ground.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

<u>Sample for Non-Volatile Analyses</u> - Includes all chemical parameters other than volatile organics (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

<u>Split-Barrel Sampler</u> - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2 to 3.5 inches OD. The larger sizes are commonly used when a larger volume of sample material is required (see Attachment B).

<u>Test Pit and Trench</u> - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher, excavator, or bulldozer).

Subject	Number	Page
	SA-1.3	3 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

<u>Thin-Walled Tube Sampler</u> - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

<u>Project Manager</u> - The Project Manager is responsible for determining the sampling objectives, selecting proposed sampling locations, and selecting field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring, and excavation activities and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation, and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface, near-surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits, and trenches and for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

<u>Project Geologist/Sampler</u> - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and/or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

<u>Competent Person</u> - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather)
 conditions.

Subject	Number	Page
	SA-1.3	4 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

• Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Health and safety precautions are identified for individual sample collection procedures throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard or uneven surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas, along roadways and highways.

Methods of avoiding these hazards are provided below.

Knee injuries – If kneeling is required during soil sampling, this could result in knee injuries from stones/foreign objects and general damage due to stress on the joints. To minimize this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.
- Stretch ligaments, tendons and muscles before, during and after. Take breaks as frequently as necessary.
- Report pre-existing conditions to the SSO if you feel this activity will aggravate an existing condition.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample locations. To minimize these hazards:

- Pre-survey sampling locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations - To prevent cuts and lacerations associated with soil sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	5 of 31
	Revision	Effective Date
	9	04/07/2008

- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.
- Secure items to be cut do not hold them against the opposing hand, a leg, or other body part.
- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken sample jars or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities ASSUME THEY DO NOT SEE YOU OR MEMBERS
 OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site
 personnel to move into the flow of traffic to avoid your activities or equipment or that will create a
 blind spot.
- Provide a required free space of travel. Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver.
 Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

6.0 PROCEDURES

The following procedures address surface and subsurface sampling.

CAUTION

Each situation must be evaluated individually to determine the applicability and necessity for obtaining a utility clearance ticket/dig permit. Common sense dictates, prior to digging or boring with power equipment, no matter what the depth, or digging by hand in a manner that could damage unprotected underground utilities, that a dig permit is required. See SOP HS-1.0, Utility Locating and Excavation Clearance, for additional clarification. If you do not know or are unsure as to whether a ticket is necessary – **Get**the **Ticket**.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	6 of 31
	Revision 9	Effective Date 04/07/2008

6.1 <u>Overview</u>

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate to the water table, and can establish the amount of contamination absorbed or adsorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during sampling operations, particularly noting sampling locations, depths, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. Certain vegetation species can create degradation products that can alter contaminant concentrations in soil. This is why vegetation types and extent of degradation of this foliage must be recorded. To prevent degradation, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible after collection. In addition, to the extent possible, vegetation should be removed from the sample.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. It is the intent of this document to present the most commonly employed soil sampling methods used at hazardous waste sites.

6.2 Soil Sample Collection

6.2.1 Procedure for Preserving and Collecting Soil Samples for Volatile Organic Compound Analysis

Samples collected using traditional methods such as collection in a jar with no preservation have been known to yield non-representative samples due to loss of volatile organic compounds (VOCs). To prevent such losses, preservation of samples with methanol or sodium bisulfate may be used to minimize volatilization and biodegradation. This preservation may be performed either in the field or laboratory, depending on the sampling methodology employed. Because of the large number of sampling methods and associated equipment required, careful coordination between field and laboratory personnel is needed.

Soil samples to be preserved by the laboratory are currently being collected using Method SW-846, 5035. For samples preserved in the field, laboratories are currently performing low-level analyses (sodium bisulfate preservation) and high- to medium-level analyses (methanol preservation) depending on the needs of the end user.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

6.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organic analysis that are to be preserved at the laboratory shall be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample shall be

Subject	Number	Page
SOIL SAMPLING	SA-1.3	7 of 31
	Revision	Effective Date
	9	04/07/2008

obtained using a reusable sampling handle (T-handle) that can be provided with the EnCore™ sampler when requested and purchased. Collect the sample in the following manner for each EnCore™ sampler:

- 1. Scene Safety Evaluate the area where sampling will occur. Ensure that the area is safe from physical, chemical, and natural hazards. Clear or barricade those hazards that have been identified.
- 2. Wear the appropriate personal protective equipment (PPE). This will include, at a minimum, safety glasses and nitrile surgeon's gloves. If you must kneel on the ground or place equipment on the surface being sampled, cover the ground surface with plastic to minimize surface contamination of your equipment and clothing. Wear knee pads to protect your knees from kneeling on hard or uneven surfaces.
- 3. Load the Encore™ sampler into the T-handle with the plunger fully depressed.
- 4. Expose the area to be sampled using a hand trowel or similar device to remove surface debris.
- 5. Press the T-handle against the freshly exposed soil surface, forcing soil into the sampler. The plunger will be forced upward as the cavity fills with soil.
- 6. When the sampler is full, rotate the plunger and lock it into place. If the plunger does not lock, the sampler is not full. This method ensures there is no headspace. Soft soil may require several plunges or forcing soil against a hard surface such as a sample trowel to ensure that headspace is eliminated.
- 7. Use a paper towel to remove soil from the side of the sampler so a tight seal can be made between the sample cap and the rubber O-ring.
- 8. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.
- 9. Remove any surface soil from the outside of the sampler and place in the foil bag provided with the sampler. Good work hygiene practices and diligent decontamination procedures prevents the spread of contamination even on the outside of the containers.
- 10. Label the bag with appropriate information in accordance with SOP SA-6.3.
- 11. Place the full sampler inside a lined cooler with ice and cool to 4°C ± 2°C. Make sure any required trip blanks and temperature blanks are also in the cooler. Secure custody of the cooler in accordance with SOP SA-6.3.
- 12. Typically, collect three Encore™ samplers at each location. Consult the SAP or laboratory to determine the required number of Encore™ samplers to be collected.
- 13. The T-handle shall be decontaminated before moving to the next interval or location using a soap and water wash and rinse, and where applicable, the selected solvent as defined in the project planning documents.

Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each Encore™ sampler.

After the Encore™samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	8 of 31
	Revision	Effective Date
	9	04/07/2008

6.2.1.2 <u>Soil Samples to be Preserved in the Field</u>

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) and high- to medium-level (methanol preservation) methods.

Safety Reminder

When using chemicals in the field to preserve samples, the FOL and/or SSO must ensure that Materials Safety Data Sheets (MSDSs) have been provided with the chemicals to be used. They also must ensure that these chemicals have been added to the Chemical Inventory List contained within Section 5.0, Hazard Communication, of your Health and Safety Guidance Manual (HSGM). Lastly, but most importantly, the FOL and/or SSO must review the hazards with personnel using these chemicals and ensure that provisions are available for recommended PPE and emergency measures (e.g., eyewash, etc.).

Methanol Preservation (High to Medium Level):

Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Soil samples to be preserved in the field with methanol shall utilize 40 to 60 mL glass vials with septum-lined lids. Each sample bottle shall be filled with 25 mL of demonstrated analyte-free purge-and-trap grade methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

CAUTION

NEVER attempt to pipette by mouth

In situations where personnel are required to spike the septum using a hypodermic needle, the following provisions for handling sharps must be in place:

- Training of personnel regarding methods for handling of sharps
- Hard-sided containers for the disposal of sharps
- Provisions for treatment in cases where persons have received a puncture wound

Soil shall be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol-preserved sample bottle. Calibration of the scale shall be performed prior to use and intermittently throughout the day according to the manufacturer's requirements.

The sample should be collected as follows:

- 1. Weigh the unused syringe and plunger to the nearest 0.01 gram.
- 2. Pull the plunger back and insert the syringe into the soil to be sampled.
- 3. Collect 8 to 12 grams of soil by pushing the syringe barrel into the soil.
- 4. Weigh the sample and adjust until obtaining the required amount of sample.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	9 of 31
	Revision	Effective Date
	9	04/07/2008

- Record the sample weight to the nearest 0.01 gram in the field logbook and/or on the sample log sheet.
- 6. Extrude the weighed soil sample into the methanol-preserved sample bottle taking care not to contact the sample container with the syringe.
- 7. If dirty, wipe soil particles from the threads of the bottle and cap. Cap the bottle tightly.
- 8. After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol.
- 9. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

Sodium Bisulfate Preservation (Low Level):

CAUTION

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soil containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode. To avoid this hazard or hazards of this type, a small sample aliquot should be subjected to the sample preservative. If it effervesces in an open air environment, utilize an alternative method such as Encore™ or 2-ounce jar.

Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be preserved in the field using the sodium bisulfate method are to be prepared and collected as follows:

- 1. Add 1 gram of sodium bisulfate to 5 mL of laboratory-grade deionized water in a 40 to 60 mL glass vial with septum-lined lid.
- 2. Collect the soil sample and record the sample weight to the nearest 0.01 gram in the field logbook or on the sample log sheet as described for methanol preservation
- 3. Add the weighed sample to the sample vial.
- 4. Collect duplicate samples using the methanol preservation method on a one-for-one sample basis because it is necessary for the laboratory to perform both low-level and medium-level analyses.
- 5. Place the samples on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

NOTE

If lower detection limits are necessary, an option to field preserving with sodium bisulfate may be to collect EnCore™ samplers at a given sample location. Consult the planning documents to determine whether this is required. If it is, collect samples in accordance with the Encore™ sampling procedure above and then send all samplers to the laboratory to perform the required preservation and analyses.

6.2.2 Procedure for Collecting Soil Samples for Non-Volatile Analyses

Samples collected for non-volatile analyses may be collected as either grab or composite samples as follows:

Subject	Number	Page
SOIL SAMPLING	SA-1.3	10 of 31
	Revision	Effective Date
	9	04/07/2008

- 1. With a stainless steel trowel or other approved tool, transfer a portion of soil to be sampled to a stainless steel bowl or disposable inert plastic tray.
- 2. Remove roots, vegetation, sticks, and stones larger than the size of a green pea.
- 3. Thoroughly mix the soil in the bowl or tray to obtain as uniform a texture and color as practicable. The soil type, moisture content, amount of vegetation, and other factors may affect the amount of time required to obtain a properly mixed sample. In some cases, it may be impossible to obtain a uniform sample appearance. Use the field logbook to describe any significant difficulties encountered in obtaining a uniform mixture.
- 4. Transfer the mixed soil to the appropriate sample containers and close the containers.
- 5. Label the sample containers in accordance with SOP SA-6.3.
- 6. Place the containers in a cooler of ice as soon after collection as possible.
- 7. Prepare the sample shipment and ship the samples in accordance with SOP SA-6.1.

NOTE

Cooling may not be required for some samples depending on the scheduled analyses.

Consult the planning documents if in doubt regarding correct sample preservation conditions. When in doubt – Cool to 4°C.

NOTE

Head space is permitted in soil sample containers for non-volatile analyses to allow for sample expansion.

6.2.3 Procedure for Collecting Undisturbed Soil Samples

NOTE

Use of thin-walled undisturbed tube samplers is restricted by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soil with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soil. Using these devices normally increases sampling costs, and therefore their use should be weighed against the need for acquiring an undisturbed sample. These devices are not discussed in this SOP because they are not commonly used.

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) shall be employed using the following collection procedure:

- 1. In preparation for sampling utilizing a drill rig, field personnel must complete the following activities:
 - Ensure that all subsurface drilling activities are preceded by a utility clearance for the area to be investigated. This includes activities described in SOP HS-1.0, Utility Location and Excavation Clearance, as well as any location-specific procedures that may apply.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	11 of 31
	Revision	Effective Date
	9	04/07/2008

REMEMBER

If you are digging near a marked utility (within the diameter of an underground utility that has been marked plus 18 inches), you must first locate the utility through vacuum extraction or hand digging to ensure that your activities will not damage the utility.

- Complete an Equipment Inspection Checklist for the drill rig or direct-push technology (DPT) rig. This checklist will be provided in the HASP.
- Review the Safe Work Permit prior to conducting the activity.
- Review the activity to be conducted.
- 2. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and/or clean out the borehole to the desired sampling depth. Be careful to minimize potential disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.

CAUTION

The use of bottom-discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Only the use of side-discharge bits is permitted.

- 3. Determine whether a stationary piston-type sampler is required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used.
- 4. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal. In addition, the check valve maintains a positive suction within the tube to help retain the sample.
- 5. A stainless steel tube sampler is typically used to minimize chemical reaction between the sample and the sampling tube.
- 6. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil with a continuous and rapid motion, without impacting or twisting. If the soil is too hard to penetrate by pushing alone, careful hammering may be used by minimizing drop distance (tapping) of the hammer. Before pulling the tube, turn it at least one revolution to shear the sample off at the bottom. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
- 7. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated.
- 8. Remove disturbed material in the upper end of the tube and measure the length of sample again.
- 9. After removing at least 1 inch of soil from the lower end, place enough packing material (clean inert material such as paper or cloth) tightly in each end of the Shelby tube and then pour melted wax into each end to make at least a ½-inch wax plug and then add more packing material to fill the voids at both ends.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	12 of 31
	Revision	Effective Date
	9	04/07/2008

- 10. Place plastic caps on the ends, tape the caps in place, and dip the ends in wax to prevent loss of soil.
- 11. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label.
- 12. Mark the "up" direction on the side and upper end of the tube with indelible ink.
- 13. Complete a chain-of-custody form (see SOP SA-6.3) and other required forms (including Attachment A of this SOP).
- 14. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

CAUTION

To preserve sample integrity do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times.

CAUTION

A primary concern in the preparation of the wax plugs is the potential for the heat source and melted wax to cause a fire and/or burns. Follow the directions below to prevent injury or fire.

Electrical Heating

Using hot plates to melt the wax is acceptable. In an outdoor setting, make sure a Ground Fault Circuit Interrupter (GFCI) is employed within the electrical circuit. If a portable generator is used, ensure that the generator is an adequate distance from the sampling operation (at least 50 feet). Ensure that the extension cord is rated for the intended load and for outdoor use and is free from recognizable damage. Ensure flammable preservatives are not employed or stored near the hot plate. Although a Hot Work Permit is not required, scene safety evaluation by site personnel of the above elements is. As always, if a fire potential exists, the provisions for extinguishing must be immediately accessible as well as any provisions for first aid measures.

Open Flame

If an open flame is used, the following provisions are necessary:

- Complete a Hot Work Permit and any local permit required for elevated temperature applications. The Hot Work Permit, provided in your HASP, will aid the FOL and/or the SSO in ensuring that fire protection provisions (extinguishers, fire watches, etc.) are in place as well as ensuring that local requirements have been addressed.
- Ensure that water is available to address any wax splashes or contact. If possible, immerse the contacted area. Where this is not possible, run water over the area and apply cold compresses. The need for medical attention or first aid shall be determined on site under the direction of the SSO.

Subject	Number SA-1.3	Page 13 of 31
SOIL SAMPLING	Revision 9	Effective Date 04/07/2008

6.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples for subsequent analysis is by use of a stainless steel shovel, hand auger, soil corer, or stainless steel or disposable plastic trowel.

NOTE

Multiple depth intervals are used to describe surface soil. Sometimes surface soil is defined as soil from 0 to 2 inches below ground surface (bgs), and sometimes it is defined as soil from other depths such as 0 to 2 feet bgs. Ensure that the definition of surface soil depth is clear before collecting surface soil samples.

For the purposes of instruction, the terms "surface soil" and "near-surface soil" are used in this SOP as follows:

- Surface soil 0 to 6 inches bgs
- Near-surface soil 6 to 18 inches bgs

If these intervals are defined differently in the planning documents, substitute the appropriate depth ranges.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Stainless steel hand auger, soil corer, or shovel.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in project planning document.
- Required PPE.
 - Nitrile surgeon's or latex gloves may be used, layered as necessary.
 - Safety glasses
 - Other Items identified on the Safe Work Permit may be required based on location-specific requirements such as hearing protection, steel-toed work boots, and a hard hat when working near a drill rig. These provisions will be listed in the HASP or directed by the FOL and/or SSO.

Safety Reminder

The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP)
- Required decontamination equipment
- Required sample container(s)
- Wooden stakes or pin flags

Subject	Number	Page
	SA-1.3	14 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

- Sealable polyethylene bags (e.g., Ziploc® baggies)
- Heavy duty cooler
- Ice
- Chain-of-custody records and custody seals

When acquiring surface soil samples, use the following procedure:

- 1. Place padding or use knee pads when kneeling near the sample location. If necessary, place plastic sheeting to provide a clean surface for sample equipment to avoid possible cross- contamination.
- 2. Carefully remove vegetation, roots, twigs, litter, etc. to expose an adequate soil surface area to accommodate sample volume requirements.
- 3. Using a precleaned syringe or EnCoreTM samplers, follow the procedure in Section 6.2.1 for collecting surface soil samples for volatile analysis. Surface soil samples for volatile organic analysis should be collected deeper than 6 inches bgs because shallower material has usually lost most of the volatiles through evaporation. Ensure that the appropriate surface soil depth is being analyzed in accordance with the planning document.
- 4. Using decontaminated sampling tools, thoroughly mix in place a sufficient amount of soil to fill the remaining sample containers. See Section 6.5 of this procedure for hand auger instruction, as needed.
- 5. Transfer the sample into those containers utilizing a stainless steel trowel.
- 6. Cap and securely tighten all sample containers.
- 7. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.
- 8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.
- 9. Site restoration Whenever removing sample materials, always restore the surface. It is our intent to leave the area better than we found it. Do NOT create trip hazards in areas when pedestrian traffic may exist.

6.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6 to 18 inches) can be accomplished with tools such as shovels, hand auger, soil corers, and stainless steel or pre-cleaned disposable trowels and the equipment listed under Section 6.5 of this procedure.

To obtain near-surface soil samples, the following protocol shall be used:

- 1. With a clean shovel, make a series of vertical cuts in the soil to the depth required to form a square approximately 1 foot by 1 foot.
- 2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.

Subject	Number SA-1.3	Page 15 of 31
SOIL SAMPLING	Revision 9	Effective Date 04/07/2008

3. Follow steps 1 through 9 of Section 6.3.

6.5 Subsurface Soil Sampling With a Hand Auger

A hand augering system generally consists of a variety of stainless steel bucket bits (approximately 6.5 inches long and 2, 2.75, 3.25, and 4 inches in diameter), series of extension rods (available in 2-, 3-, 4- and 5-inch lengths), and a T-handle connected to extension rods and to the auger bucket. A larger-diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then it is withdrawn. The larger-diameter bit is then replaced with a smaller-diameter bit, lowered down the hole, and slowly turned into the soil to the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil either from the surface, or to depths in excess of 12 feet. However, the presence of subsurface rocks and landfill material and collapse of the borehole normally limit sampling depth.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes)
- Stainless steel mixing bowls
- The equipment listed in Section 6.3
- Miscellaneous hand tools as required to assemble and disassemble the hand auger units

CAUTION

Potential hazards associated with hand augering include:

- Muscle strain and sprain due to over twisting and/or over compromising yourself.
- Equipment failure due to excessive stress on the T-handle or rods through twisting. Failure of any of these components will result in a sudden release and potential injury due to that failure.

As in all situations, any intrusive activities that could damage underground utilities shall be proceeded by a Dig/Excavation permit/ticket. Call the Utility Locating service in the area or your Project Health and Safety Officer for more information. When in doubt – **Get the Ticket!**

To obtain soil samples using a hand auger, use the following procedure:

- 1. Wearing designated PPE, attach a properly decontaminated bucket bit to a clean extension rod and attach the T-handle to the extension rod.
- 2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
- 3. Twist the bucket into the ground while pushing vertically downward on the auger. The cutting shoes fill the bucket as it is advanced into the ground.
- 4. As the auger bucket fills with soil, periodically remove any unneeded soil.

Subject	Number	Page 40 of 24
SOIL SAMPLING	SA-1.3	16 of 31
	Revision	Effective Date
	9	04/07/2008

- 5. Add rod extensions as necessary to extend the reach of the auger. Also, note (in a field notebook, boring log, and/or on a standardized data sheet) any changes in the color, texture or odor of the soil as a function of depth. The project-specific planning document (SAP, HASP, etc.) describe requirements for scanning the soil with a real-time air monitoring instrument (e.g., PID, FID, etc.) and recording the measurements.
- 6. After reaching the desired depth (e.g., the top of the interval to be sampled), slowly and carefully withdraw the apparatus from the borehole to prevent or minimize movement of soil from shallower intervals to the bottom of the hole.
- 7. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is to be smaller in diameter than the bucket bit employed to initiate the borehole.
- 8. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
- 9. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
- 10. Discard the top of the core (approximately 1 inch), which represents any loose material collected by the bucket bit before penetrating the sample material.
- 11. Using a precleaned syringe or EnCore[™] samplers, follow the procedure in Section 6.2.1 for collecting a soil sample for volatile compound analysis directly from the bucket bit.
- 12. Utilizing a properly decontaminated stainless steel trowel or dedicated disposable trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl.
- 13. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers. Refer to Section 6.2.2.
- 14. Follow steps 4 through 7 listed in Section 6.3.

6.5.1 Sampling Using Stainless Steel Soil Corers

A soil corer is a stainless steel tube equipped with a cutting shoe and sample window in the side. The soil corer is advanced into the soil by applying downward pressure (body weight). The soil is unloaded by then forcing a ram towards the cutting shoe, which results in the discharge of the soil core through a window in the sleeve.

Use, application, and sample protocol is the same as for hand augering provided above, but without necessarily rotating the corer while advancing it.

SAFETY REMINDER

Hand augering and soil corer sampling can be physically demanding based on the type of geology and subsurface encumbrances encountered. Soil coring has some added hazards such the corer collapsing under your weight. To reduce the potential for muscle strain and damage, the following measures will be incorporated:

- Stretch and limber your muscles before heavy exertion. This hazard becomes more predominant in the early morning hours (prior to muscles becoming limber) and later in the day (as a result of fatigue).

Subject	Number	Page
	SA-1.3	17 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

- Job rotation Share the duties so that repetitive actions do not result in fatigue and injury.
- Increase break frequencies as needed, especially as ambient conditions of heat and/or cold stress may dictate.
- Do not force the hand tools or use cheater pipes or similar devices to bypass an obstruction. Move to another location near the sampling point. Exerting additional forces on the sampling devices can result in damage and/or failure that could potentially injure someone in the immediate vicinity.
- Do not over compromise yourself when applying force to the soil corer or hand auger. If there is a sudden release, it could result in a fall or muscle injury due to strain.

6.6 <u>Subsurface Soil Sampling with a Split-Barrel Sampler</u>

A split-barrel (split-spoon) sampler consists of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-pound or larger casing driver.

Safety Reminder

It is intended through the Equipment Inspection for Drill Rigs form provided in the HASP that the hammer and hemp rope, where applicable, associated with this activity will be inspected (no physical damage is obvious), properly attached to the hammer (suitable knots or sufficient mechanical devices), and is in overall good condition.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (2-inch OD, 1-3/8-inch ID, either 20 inches or 26 inches long); Larger OD samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-pound weight, driving head, and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed in Section 6.3.

The following steps shall be followed to obtain split-barrel samples (Steps 1 through 4 are typically performed by the drilling subcontractor):

1. Attach the split-barrel sampler to the sampling rods.

Subject	Number	Page
	SA-1.3	18 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

- 2. Lower the sampler into the borehole inside the hollow stem auger bits.
- 3. Advance the split-barrel sampler by hammering the length (typically 18 or 24 inches) of the split-barrel sampler into the soil using 140-pound or larger hammer.
- 4. When the desired depth is achieved, extract the drill rods and sampler from the augers and/or borehole.
- 5. Detach the sampler from the drill rods.
- 6. Place the sampler securely in a vise so it can be opened using pipe wrenches.

CAUTION

Pipe wrenches are used to separate the split spoon into several components. The driller's helper should not apply excessive force through the use of cheater pipes or push or pull in the direction where, if the wrench slips, hands or fingers will be trapped against an immovable object.

- 7. Remove the drive head and nosepiece with the wrenches, and open the sampler to reveal the soil sample.
- 8. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.) (as project-specific planning documents dictate). Carefully separate (or cut) the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.
- 9. If elevated vapor readings were observed, collect the sample scheduled for volatile analysis from the center of the core where elevated readings occurred. If no elevated readings where encountered, the sample material should be collected from the core's center (this area represents the least disturbed area with minimal atmospheric contact) (refer to Section 6.2.1).
- 10. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl.
- 11. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers (refer to Section 6.2.2).
- 12. Follow steps 4 through 7 in Section 6.3.

6.7 <u>Subsurface Soil Sampling Using Direct-Push Technology</u>

Subsurface soil samples can be collected to depths of 40+ feet using DPT. DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

Subject	Number	Page
	SA-1.3	19 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

6.8 <u>Excavation and Sampling of Test Pits and Trenches</u>

6.8.1 Applicability

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

CAUTION

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise from the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P -Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden, steel, or aluminum support structures or through sloping and benching. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments; therefore, monitoring will be conducted by the Competent Person to determine if it is safe to enter. Any entry into a trench greater than 4 feet deep will constitute a Confined Space Entry and must be conducted in conformance with OSHA standard 29 CFR 1910.146. In all cases involving entry, substantial air monitoring, before entry, appropriate respiratory gear and protective clothing determination, and rescue provisions are mandatory. There must be at least three people present at the immediate site before entry by one of the field team members. This minimum number of people will increase based on the potential hazards or complexity of the work to be performed. The reader shall refer to OSHA regulations 29 CFR 1926.650, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146. Highhazard entries such as this will be supported by members of the Health Sciences Group

Excavations are generally not practical where a depth of more than about 15 to 20-feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If soil data at depths greater than 15-feet are required, the data are usually obtained through test borings instead of test pits.

professionally trained in these activities.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

6.8.2 Test Pit and Trench Excavation

Test pits or trench excavations are constructed with the intent that they will provide an open view of subsurface lithology and/or disposal conditions that a boring will not provide. These procedures describe the methods for excavating and logging test pits and trenches installed to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

Test pits and trenches may be excavated by hand or power equipment to permit detailed descriptions of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

• The purpose and extent of the exploration

Subject	Number	Page
	SA-1.3	20 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

- The space required for efficient excavation
- The chemicals of concern
- The economics and efficiency of available equipment

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table provides guidelines for design consideration based on equipment efficiencies.

Equipment	Typical Widths, in Feet
Trenching machine	0.25 to 1.0
Backhoe/Track Hoe	2 to 6

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, the following field conditions may necessitate revisions to the initial plans:

- Subsurface utilities
- Surface and subsurface encumbrances
- Vehicle and pedestrian traffic patterns
- Purpose for excavation (e.g., the excavation of potential ordnance items)

The final depth and construction method shall be collectively determined by the FOL and designated Competent Person. The actual layout of each test pit, temporary staging area, and spoils pile may further be predicated based on site conditions and wind direction at the time the test pit is excavated. Prior to excavation, the area may be surveyed by magnetometer or metal detector or other passive methods specified in SOP HS1.0, Utility Location and Excavation Clearance, to identify the presence of underground utilities or drums. Where possible, the excavator should be positioned upwind and preferably within an enclosed cab.

No personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is required, OSHA requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be placed for every 25 feet of lateral travel and extended 3 feet above ground surface). A temporary guard rail or vehicle stop must be placed along the surface of the hole before entry in situations where the excavation may be approached by traffic. Spoils will be stockpiled no closer than 2 feet from the sidewall of the excavation. The excavation equipment operator shall be careful not to undercut sidewalls and will, where necessary, bench back to increase stability. The top cover, when considered clean, will be placed separately from the subsurface materials to permit clean cover. It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example,

Subject	Number	Page
	SA-1.3	21 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

samples of leachate, groundwater, or sidewall soil can be collected with telescoping poles or similar equipment.

Dewatering and watering may be required to ensure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation stable. This is an important consideration for excavations in cohesionless material below the groundwater table and for excavations left open greater than a day. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

Where possible excavations and test pits shall be opened and closed within the same working day. Where this is not possible, the following engineering controls shall be put in place to control access:

- Trench covers/street plates
- Fences encompassing the entire excavation intended to control access
- Warning signs warning personnel of the hazards
- Amber flashing lights to demarcate boundaries of the excavation at night

Excavations left open will have emergency means to exit should someone accidentally enter.

6.8.3 Sampling in Test Pits and Trenches

6.8.3.1 General

Log test pits and trenches as they are excavated in accordance with the Test Pit Log presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable health and safety and OSHA requirements have been met as stated above. These provisions will be reiterated as appropriate in the project-specific HASP.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information includes soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples that can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

6.8.3.2 <u>Sampling Equipment</u>

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

Subject	Number SA-1.3	Page 22 of 31
SOIL SAMPLING	Revision 9	Effective Date 04/07/2008

- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container bucket with locking lid for large samples; appropriate bottle ware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps, and right angle adapter for conduit (see Attachment D).

6.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 6.8.3.4.

- Excavate the trench or pit in several 0.5- to 1.0-foot depth increments. Where soil types support the
 use of a sand bar cutting plate, use of this device is recommended to avoid potentially snagging
 utilities with the excavator teeth. It is recommended that soil probes or similar devices be employed
 where buried items or utilities may be encountered. This permits the trench floor to be probed prior to
 the next cut.
- After each increment:
 - the operator shall wait while the sampler inspects the test pit from grade level
 - the sampler shall probe the next interval where this is considered necessary. Practical depth increments for lithological evaluations may range from 2 to 4 feet i or where lithological changes are noted.
- The backhoe operator, who will have the best view of the test pit, shall immediately cease digging if:
 - Any fluid phase, including groundwater seepage, is encountered in the test pit
 - Any drums, other potential waste containers, obstructions, or utility lines are encountered
 - Distinct changes of material being excavated are encountered

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending on the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Use the backhoe to remove loose material from the excavation walls and floor to the greatest extent possible.
- Secure the walls of the pit, if necessary. (There is seldom any need to enter a pit or trench that would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)

Subject	Number	Page
	SA-1.3	23 of 31
SOIL SAMPLING	Revision	Effective Date
	9	04/07/2008

- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material after it has been deposited on the ground, as follows:
 - a. The sampler or FOL shall direct the backhoe operator to remove material from the selected depth or location within the test pit/trench.
 - b. The backhoe operator shall bring the bucket over to a designated location on the sidewall a sufficient distance from the pit (at least 5 feet) to allow the sampler to work around the bucket.
 - c. After the bucket has been set on the ground, the backhoe operator shall either disengage the controls or shut the machine down.
 - d. When signaled by the operator that it is safe to do, the sampler will approach the bucket.
 - e. The soil shall be monitored with a photoionization or flame ionization detector (PID or FID) as directed in the project -specific planning documents.
 - f. The sampler shall collect the sample from the center of the bucket or pile in accordance with surface soil sampling procedures of Section 6.3 or 6.4, as applicable. Collecting samples from the center of a pile or bucket eliminates cross-contamination from the bucket or other depth intervals.
- If a composite sample is desired, several depths or locations within the pit/trench will be selected, and the bucket will be filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.

CAUTION

Care must be exercised when using the remote sampler described in the next step because of potential instability of trench walls. In situations where someone must move closer than 2 feet to the excavation edge, a board or platform should be used to displace the sampler's weight to minimize the chance of collapse of the excavation edge. Fall protection should also be employed when working near the edges or trenches greater than 6 feet deep. An immediate means to extract people who have fallen into the trench will be immediately available. These means may include ladders or rope anchor points.

- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the sidewall or bottom of the pit as follows:
 - a. Scrape the face of the pit/trench using a long-handled shovel or hoe to remove the smeared zone that has contacted the backhoe bucket.
 - b. Collect the sample directly into the sample jar, by scraping with the jar edge, eliminating the need for sample handling equipment and minimizing the likelihood of cross-contamination.
 - c. Cap the sample jar, remove it from the remote sampler assembly, and package the sample for shipment in accordance with SOP SA-6.3.
- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	24 of 31
	Revision 9	Effective Date 04/07/2008

6.8.3.4 <u>In-Pit Sampling</u>

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soil or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- There are no practical alternative means of obtaining such data.
- The SSO and Competent Person determine that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of oxygen concentration, flammable gases, and toxic compounds, in that order). Action levels will be provided in project-specific planning documents.
- A company-designated Competent Person determines that the pit/trench is stable trough soil
 classification evaluation/inspections or is made stable (by cutting/grading the sidewalls or using
 shoring) prior to entrance of any personnel. OSHA requirements shall be strictly observed.

If these conditions are satisfied, only one person may enter the pit/trench. On potentially hazardous waste sites, this individual shall be dressed in selected PPE as required by the conditions in the pit. He/she shall be affixed to a harness and lifeline and continuously monitored while in the pit.

A second and possible third individual shall be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations to support self rescue or assisted self rescue. The individual entering the pit shall remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon.

6.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 6.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., thin walled tube samplers), that can be pushed or driven into the floor of the test pit.
- Suitable driving (e,g., sledge hammer) or pushing (e.g., backhoe bucket) equipment used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Subject	Number SA-1.3	Page 25 of 31
SOIL SAMPLING	Revision 9	Effective Date 04/07/2008

Disturbed grab or bulk geotechnical soil samples may be collected for most soil in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification: larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soil using thin-walled tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability, and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the tube when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 6.8.3.4 shall be followed. The thin-walled tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate because the sample will not have the correct orientation.

A sledge hammer or backhoe may be used to drive or push the tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. When using a sledge hammer, it is recommended that the sampler be stabilized using a rope/strap wrench or pipe wrench to remove the person's hands holding the sampler from the strike zone. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hook the sampler to the excavator or backhoe and extract. This means an alternative head will be used as a connection point or that multiple choke hitches will be applied to extract the sampler. If this fails and the excavator can dig deeper without potentially impacting subsurface utilities, excavate the sampler. If this fails or if the excavator cannot be used due to subsurface utilities, hand excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry into the test pit, the requirements in Section 6.8.3.4 must be followed. Prepare the sample as described in Steps 9 through 13 in Section 6.2.3, and label, pack and transport the sample in the required manner, as described in SOPs SA 6.3 and SA 6.1.

6.8.4 Backfilling of Trenches and Test Pits

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew may photograph, if required by the project-specific work plan, all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL. Backfill should be returned to the trench or test pit in 6-inch to 1-foot lifts and compacted with the bucket. Remote controlled tampers or rollers may be lowered into the trench and operated from top side. This procedure will continue to the grade surface. It is recommended that the trench be tracked or rolled in. During excavation, clean soil from the top 2 feet may have been separated to be used to cover the last segments. Where these materials are not clean, it is recommended that clean fill be used for the top cover.

Subject	Number	Page
SOIL SAMPLING	SA-1.3	26 of 31
	Revision	Effective Date
	9	04/07/2008

If a low-permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

6.9 Records

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler for all samples collected. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining GPS coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. If the project-specific work plan requires photographs, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits, and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job
- Date of boring and excavation
- Approximate surface elevation
- Total depth of boring and excavation
- Dimensions of pit
- Method of sample acquisition
- Type and size of samples
- Soil and rock descriptions
- Photographs if required
- Groundwater levels
- PID/FID/LEL/O₂ meter readings
- Other pertinent information, such as waste material encountered

In addition, site-specific documentation to be maintained by the SSO and/or Competent Person will be required including:

- Calibration logs
- Excavation inspection checklists

Subject	Number	Page 07 - 4 04
SOIL SAMPLING	SA-1.3	27 of 31
	Revision	Effective Date
	9	04/07/2008

• Soil type classification

7.0 REFERENCES

American Society for Testing and Materials, 1987. <u>ASTM Standards D1587-83 and D1586-84</u>. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

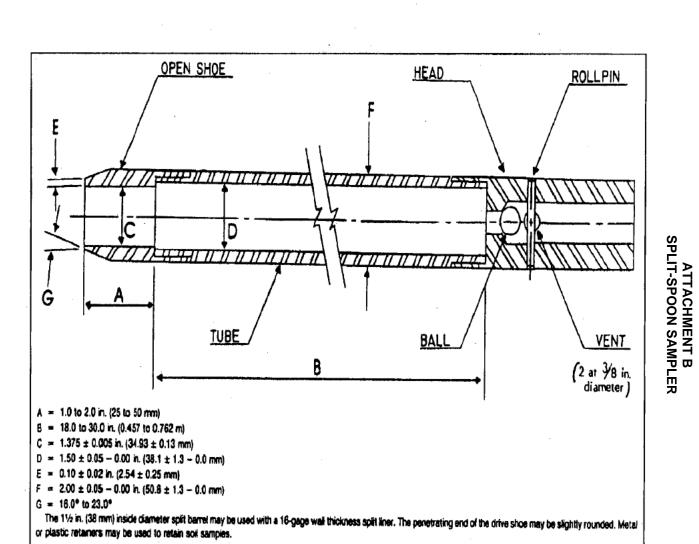
OSHA, Confined Space Entry 29 CFR 1910.146.

USEPA, November 2001. <u>Environmental Investigations Standard Operating Procedures and Quality</u> Assurance Manual.

Subject	Number	Page 20 -f 24
SOIL SAMPLING	SA-1.3	28 of 31
SOIL OF WIN LINES	Revision	Effective Date
	9	04/07/2008

ATTACHMENT A SOIL & SEDIMENT SAMPLE LOG SHEET

Tetr	ra Tech NUS,	lnc.	SOIL & SEDIM	IENT SAM	PLE LOG	SHEET	Г
Project Site Nai Project No.:	_			Sample II Sample L Sampled	ocation: By:	Page_	of
[] Surface So [] Subsurface [] Sediment [] Other: [] QA Sampl	e Soil				_		
GRAB SAMPLE DAT	TA:		t by #10 c				
Date:		Depth	Color	Description	(Sand, Silt,	Clay, Moist	ure, etc.)
Time:							
Method:				-			
Monitor Reading (pp	m):						
COMPOSITE SAMP	LE DATA:		7/4 9				
Date:	Time	Depth	Color	Description	n (Sand, Silt,	Clay, Moist	ure, etc.)
Method:							
Monitor Readings							
(Range in ppm):							
(Hange III ppin).	—						
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SAMPLE COLLECT	ION INFORMATI	ON:		344			
	Analysis		Container Requ	irements	Collec	ted	Other
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OBSERVATIONS / N	NOTES:		4.5	MAP:			
Circle if Applicable:			£7	Signature(s):			
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Subject

SOIL SAMPLING

Revision

9

Effective Date 04/07/2008

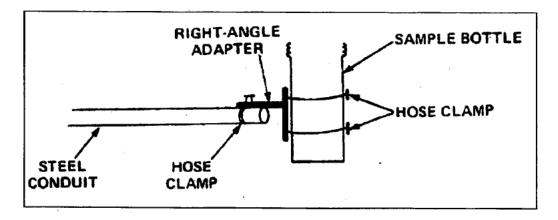
29 of 31

Number

SOIL S	VIVIDI IN	J.G		Number SA-1.3				0 of 31
SOIL SA	HIVIPLII	NG		Revision 9			Effective Da	te 4/07/20
				ATTACHMENT (TEST PIT LOG	•			
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	Tŧ	Tetra Tech	n NUS, Inc.	TEST P	IT LO	<u>G</u>	Page	_ of
		ECT NAME:		TE	ST PIT N	o.:		
	LOCA	ECT NUMBER TION:	:	GE	TE: OLOGIS	Г:		
	Depth (Ft.)	Lithology Change (Depth/Ft.)	Soil/Was	te Characteristics density, color, etc.)	U S C	Remarks	PID/FID F	EADING (wdd) Zg
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Subject SOIL SAMPLING	Number SA-1.3	Page 31 of 31
	Revision 9	Effective Date 04/07/2008

ATTACHMENT D REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING





TETRA TECH

STANDARD OPERATING PROCEDURES

Number	Page
SA-2.5	1 of 6
Effective Date 01/2012	Revision 4

Applicability

Tetra Tech, Inc.

Prepared

Earth Sciences Department

Subject DIRECT PUSH TECHNOLOGY (GEOPROBE®/HYDROPUNCH™)

Approved

J. Zimmerly

TABLE OF CONTENTS

SEC ⁻	<u> </u>		<u>PAGE</u>
1.0	PURPOSE	E	2
2.0	SCOPE		2
3.0	GLOSSAF	RY	2
4.0	RESPONS	SIBILITIES	2
5.0	SOIL SAM	IPLING PROCEDURES	3
	5.1 5.2 5.3	GENERALSAMPLING EQUIPMENTDPT SAMPLING METHODOLOGY	3
6.0	GROUND	WATER SAMPLING PROCEDURES	4
	6.1 6.2 6.3	GENERAL SAMPLING EQUIPMENT DPT TEMPORARY WELL POINT INSTALLATION AND SAMPLING METHODOLOGY	4
7.0	RECORDS	S	5
	ACHMENTS		_
1	SAFE W	ORK PERMIT	6

Subject	Number	Page
DIRECT PUSH TECHNOLOGY	SA-2.5	2 of 6
(GEOPROBE®/HYDROPUNCH™)	Revision	Effective Date
	4	01/2012

1.0 PURPOSE

The purpose of this procedure is to provide general reference information on Direct Push Technology (DPT). DPT is designed to collect soil, groundwater, and soil gas samples without using conventional drilling techniques. The advantage of using DPT over conventional drilling includes the generation of little or no drill cuttings, sampling in locations with difficult accessibility, reduced overhead clearance requirements, no fluid introduction during probing, and typical lower costs per sample than with conventional techniques. Disadvantages include a maximum penetration depth of approximately 15 to 40 feet in dense soils (although it may be as much as 60 to 80 feet in certain types of geological environments), reduced capability of obtaining accurate water-level measurements, and the inability to install permanent groundwater monitoring wells. The methods and equipment described herein are for collection of surface and subsurface soil samples and groundwater samples. Soil gas sampling is discussed in SOP SA-2.4.

2.0 SCOPE

This procedure provides information on proper sampling equipment and techniques for DPT. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

3.0 GLOSSARY

<u>Direct Push Technology (DPT)</u> - DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no investigation derived waste.

<u>Geoprobe7</u> - Geoprobe7 is a manufacturer of a hydraulically-powered, percussion/probing machines utilizing DPT to collect subsurface environmental samples. Geoprobe7 relies on a relatively small amount of static weight (vehicle) combined with percussion as the energy for advancement of a tool string. The Geoprobe7 equipment can be mounted in a multitude of vehicles for access to all types of environmental sites.

<u>HydroPunch</u> ϑ - HydroPunch ϑ is a manufacturer of stainless steel and Teflon7 sampling tools that are capable of collecting representative groundwater and/or soil samples without requiring the installation of a groundwater monitoring well or conventional soil boring. HydroPunch ϑ is an example of DPT sampling equipment.

<u>Flame Ionization Detector (FID)</u> - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing a flame as the energizing source.

<u>Photo Ionization Detector (PID)</u> - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing ultraviolet radiation as the energizing source.

4.0 RESPONSIBILITIES

<u>Project Manager</u> - The Project Manager is responsible for selecting and/or reviewing the appropriate DPT drilling procedure required to support the project objectives.

Subject DIRECT PUSH TECHNOLOGY	Number SA-2.5	Page 3 of 6
(GEOPROBE®/HYDROPUNCH™)	Revision 4	Effective Date 01/2012

<u>Field Operations Leader (FOL)</u>- The FOL is primarily responsible for performing the DPT in accordance with the project-specific plan.

5.0 SOIL SAMPLING PROCEDURES

5.1 <u>General</u>

The common methodology for the investigation of the vadose zone is soil boring drilling and soil sampling. However, drilling soil borings can be very expensive. Generally the advantage of DPT for subsurface soil sampling is the reduced cost of disposal of drilling cuttings and shorter sampling times.

5.2 Sampling Equipment

Equipment needed for conducting DPT drilling for subsurface soil sampling includes, but is not limited to, the following:

- Geoprobe[®] Sampling Kit
- Cut-resistant gloves
- 4-foot x 1.5-inch diameter macrocore sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Disposable acetate liners for soil macrocore sampler
- Cast aluminum or steel drive points
- Geoprobe® AT-660 Series Large Bore Soil Sampler, or equivalent
- Standard decontamination equipment and solutions

For health and safety equipment and procedures, follow the direction provided in the Safe Work Permit in Attachment 1, or the more detailed directions provided in the project's Health and Safety Plan.

5.3 DPT Sampling Methodology

There are several methods for the collection of soil samples using DPT drilling. The most common method is discussed in the following section. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project-specific plan.

- Macrocore samplers fitted with detachable aluminum or steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material. A Roto-hammer may also be used if very dense soils are encountered.
- The sampler is advanced continuously in 4-foot intervals or less if desired. No soil cuttings are generated because the soil which is not collected in the sampler is displaced within the formation.
- The sampler is retracted from the hole, and the 4-foot continuous sample is removed from the outer coring tube. The sample is contained within an inner acetate liner.
- Attach the metal trough from the Geoprobe® Sampling Kit firmly to the tail gate of a vehicle. If a vehicle with a tail gate is not available, secure the trough on another suitable surface.
- Place the acetate liner containing the soils in the trough.

Subject	Number	Page
DIRECT PUSH TECHNOLOGY	SA-2.5	4 of 6
(GEOPROBE®/HYDROPUNCH™)	Revision	Effective Date
	4	01/2012

- While wearing cut-resistant gloves (constructed of leather or other suitable material), cut the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe[®] Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. Do not attempt to cut the acetate liner while holding it in your hand.
- Field screen the sample with an FID or PID, and observe/examine the sample (according to SOP GH-1.3). If appropriate, transfer the sample to sample bottles for laboratory analysis. If additional volume is required, push an additional boring adjacent to the first and composite/mix the same interval. Field compositing is usually not acceptable for sample requiring volatile organics analysis.
- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes should be finished smooth to existing grade.
- In the event the direct push van/truck cannot be driven to a remote location or a sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with air/electric operated equipment (e.g., jack hammer).
- Sampling equipment is decontaminated prior to collecting the next sample.

6.0 GROUNDWATER SAMPLING PROCEDURES

6.1 General

The most common methodology for the investigation of groundwater is the installation and sampling of permanent monitoring wells. If only groundwater screening is required, the installation and sampling of temporary well points may be performed. The advantage of temporary well point installation using DPT is reduced cost due to no or minimal disposal of drilling cuttings and well construction materials, and shorter installation/times sampling.

Two disadvantages of DPT drilling for well point installation are:

- In aquifers with low yields, well points may have to be sampled without purging or development.
- If volume requirements are high, this method can be time consuming for low yield aquifers.

6.2 Sampling Equipment

Equipment needed for temporary well installation and sampling using DPT includes, but is not limited, to the following:

- 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point
- Connecting rods
- Roto-hammer with 1.5-inch bit
- Mechanical jack
- 1/4-inch OD polyethylene tubing
- 3/8-inch OD polyethylene tubing
- Peristaltic pump
- Standard decontamination equipment and solutions

Subject	Number	Page
DIRECT PUSH TECHNOLOGY	SA-2.5	5 of 6
(GEOPROBE®/HYDROPUNCH™)	Revision	Effective Date
	4	01/2012

6.3 DPT Temporary Well Point Installation and Sampling Methodology

There are several methods for the installation and sampling of temporary well points using DPT. The most common methodology is discussed below. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project specific plan.

- A 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point attached to connecting rods is
 driven into the ground to the desired depth using a rotary electric hammer or other direct push drill rig.
 If there is concrete or pavement over a sampling location, a Roto-hammer or electric coring machine
 is used to drill a hole through the surface material.
- The well point will be allowed to equilibrate for at least 15 minutes, after which a measurement of the static water level will be taken. The initial measurement of the water level will be used to assess the amount of water which is present in the well point and to determine the amount of silt and sand infiltration that may have occurred.
- The well point will be developed using a peristaltic pump and polyethylene tubing to remove silt and sand which may have entered the well point. The well point is developed by inserting polyethylene tubing to the bottom of the well point and lifting and lowering the tubing slightly while the pump is operating. The pump will be operated at a maximum rate of approximately 2 liters per minute. After removal of sediment from the bottom of the well point, the well point will be vigorously pumped at maximum capacity until discharge water is visibly clear and no further sediments are being generated. Measurements of pH, specific conductance, temperature, and turbidity shall be recorded every 5 to 10 minutes during the purging process. After two consistent readings of pH, specific conductance, temperature and turbidity (∀10 percent), the well may be sampled.
- A sample will be collected using the peristaltic pump set at the same or reduced speed as during well development. Samples (with the exception of the samples to be analyzed for volatile organic compounds, VOCs) will be collected directly from the pump discharge. Sample containers for VOCs will be filled by (first shutting off the pump) crimping the discharge end of the sample tubing when filled, removing the inlet end of the sample tubing from the well, suspending the inlet tubing above the vial, and allowing water to fill each vial by gravity flow.
- Once the groundwater sample has been collected, the connecting rods and well point will be removed
 from the hole with the direct push rig hydraulics. The hole will be backfilled with bentonite chips or
 bentonite cement grout, depending upon project requirements. Asphalt or concrete patch will be
 used to cap holes through paved or concrete areas. All holes will be finished smooth to existing
 grade.
- In the event the direct push van/truck cannot be driven to a remote location or sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with air/electric-operated equipment (e.g., jack hammer).
- Decontaminate the equipment before moving to the next location.

7.0 RECORDS

A record of all field procedures, tests, and observations must be recorded in the field logbook, boring logs, and sample log sheets, as needed. Entries should include all pertinent data regarding the investigation. The use of sketches and field landmarks will help to supplement the investigation and evaluation.

ject DIRECT PUSH TECHNOLOGY	Number SA-2.5	Page 6 of 6
(GEOPROBE®/HYDROPUNCH™)	Revision 4	Effective Date 01/2012
	ATTACHMENT 1 K PERMIT FOR DPT OPERAT	rions
Permit No. Date:	Time: From_	to
SECTION I: General Job Scope I. Work limited to the following (description through direct push technology		
II. Required Monitoring Instruments:		
III. Field Crew:		
IV. On-site Inspection conducted Y	·	or Tetra Tech
V. Protective equipment required Level D Level B Level A Detailed on Reverse Level D Minimum Requirements: Sleeved shard hats, and hearing protection will be worn	Respiratory equipm Full face APR Half face APR SKA-PAC SAF Skid Rig nirt and long pants, safety footwe	Escape Pack SCBA SCBA SCBA SCBA None Scape Pack Scape P
Modifications/Exceptions. VI. Chemicals of Concern	Action Level(s)	Response Measures
VII. Additional Safety Equipment/Proceds Hard-hat	Yes No Hearing Prof. Yes No Safety belt/h Yes No Radio Yes No Barricades Yes No Gloves (Type Yes No Work/warmin	tection (Plugs/Muffs)
VIII. Procedure review with permit accept Safety shower/eyewash (Location & Daily tail gate meetings	ors Yes NA Use)	Yes NA gency alarms
Contractor tools/equipment/PPE insp IX. Site Preparation	pected Asser	nbly points
Utility Clearances obtained for areas Physical hazards removed or blocka Site control boundaries demarcated/	ded	☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No
X. Equipment Preparation Equipment drained/depressurized Equipment purged/cleaned Isolation checklist completed Electrical lockout required/field sw Blinds/misalignments/blocks & ble Hazardous materials on walls/beh	vitch testededs in place	Yes NA
XI. Additional Permits required (Hot wor		
XII. Special instructions, precautions:		
		_



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

Number	Page
SA-6.1	1 of 11
Effective Date	Revision
02/04	3
	** * '

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Approved

D. Senovich

Subject

NON-RADIOLOGICAL SAMPLE HANDLING

TABLE OF CONTENTS

SECT	<u>PAGE</u>
1.0	PURPOSE2
2.0	SCOPE2
3.0	GLOSSARY2
4.0	RESPONSIBILITIES3
5.0	PROCEDURES 3 5.1 SAMPLE CONTAINERS 3 5.2 SAMPLE PRESERVATION 3 5.2.1 Overview 4 5.2.2 Preparation and Addition of Reagents 4 5.3 FIELD FILTRATION 5 5.4 SAMPLE PACKAGING AND SHIPPING 6 5.4.1 Environmental Samples 6
6.0	REFERENCES
ATTA	IMENTS
	GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Subject	Number	Page
NON-RADIOLOGICAL SAMPLE	SA-6.1	2 of 11
HANDLING	Revision	Effective Date
] 3	02/04

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

<u>Hazardous Material</u> - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

<u>Marking</u> - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

<u>n.o.i</u> - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

<u>Packaging</u> - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

<u>Placard</u> - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid HCl
- Sulfuric Acid H₂SO₄
- Nitric Acid HNO₃
- Sodium Hydroxide NaOH

Subject NON-RADIOLOGICAL SAMPLE	Number SA-6.1	Page 3 of 11
HANDLING	Revision 3	Effective Date 02/04

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate Na₂S₂O₃

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

<u>Sample</u> - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

<u>Field Operations Leader</u> - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

<u>Field Samplers</u> - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

Subject NON-RADIOLOGICAL SAMPLE	Number SA-6.1	Page 4 of 11
HANDLING	Revision 3	Effective Date 02/04

changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO₃, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCI)	1 part concentrated HCI: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H ₂ SO ₄)	1 part concentrated H ₂ SO ₄ : 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO ₃)	Undiluted concentrated HNO ₃	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

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Subject NON-RADIOLOGICAL SAMPLE	Number SA-6.1	Page 5 of 11
HANDLING	Revision 3	Effective Date 02/04

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- · Cap sample bottle and seal securely.

Additional considerations are discussed below:

 To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

Continue with proper base preservation of the sample as described above.

• Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

The sample pH is then raised to 9 using the NaOH preservative.

 Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed <u>prior to</u> the preservation of samples as described above. General procedures for field filtration are described below:

• The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

Subject	Number	Page
NON-RADIOLOGICAL SAMPLE	SA-6.1	6 of 11
HANDLING	Revision 3	Effective Date 02/04

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.
- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally
 described above.

5.4 Sample Packaging and Shipping

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either <u>environmental</u> or <u>hazardous</u> <u>material samples</u>. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)
- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.
- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.
- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.
- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Subject NON-RADIOLOGICAL SAMPLE	Number SA-6.1	Page 7 of 11
HANDLING	Revision 3	Effective Date 02/04

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

6.0 REFERENCES

American Public Health Association, 1981. <u>Standard Methods for the Examination of Water and Wastewater</u>, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). <u>Dangerous Goods Regulations</u>, Montreal, Quebec, Canada.

- U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.
- U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.
- U.S. EPA, 1979. <u>Methods for Chemical Analysis of Water and Wastes</u>. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 8 of 11
	Revision 3	Effective Date 02/04

ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample T	ype and Concentra	tion	Container ⁽¹⁾	Sample Size	Preservation ⁽²⁾	Holding Time ⁽²⁾
WATER				<u> </u>		
Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days ⁽⁹⁾
	Extractables SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1L	HNO ₃ to pH ≤2	6 months (Hg-28 days
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days
SOIL	<u> </u>		•			•
(GČ&GC/MS)	VOC		EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorga nic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
AIR						
Volatile Organics	Low/Medium	·	Charcoal tube 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended

All glass containers should have Teflon cap liners or septa. See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

Subject	Number	Page
NON-RADIOLOGICAL SAMPLE HANDLING	SA-6.1	9 of 11
	Revision	Effective Date
	3	02/04

ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾
INORGANIC TESTS:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H₂SO₄ to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid ⁽⁵⁾	14 days ⁽⁶⁾
Fluoride	Р	None required	28 days
Hardness	P, G	HNO ₃ to pH 2; H ₂ SO ₄ to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H₂SO₄ to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H ₂ SO ₄ to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenois	G	Cool, 4°C; H₂SO₄ to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 10 of 11
	Revision 3	Effective Date 02/04

ATTACHMENT B ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES PAGE TWO

Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾	
INORGANIC TESTS (Cont'd):				
Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days	
Sulfite	P, G	None required	Analyze immediately	
Turbidity	P, G	Cool, 4°C	48 hours	
METALS:(7)				
Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours	
Mercury (Hg)	P, G	HNO₃ to pH 2	28 days	
Metals, except Chromium VI and Mercury	P, G	HNO ₃ to pH 2	6 months	
ORGANIC TESTS:(8)				
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	14 days	
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ HCl to pH 2 ⁽⁹⁾	14 days	
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ adjust pH to 4-5 ⁽¹⁰⁾	14 days	
Phenois ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction 40 days after extraction	
Benzidines ^{(11), (12)}	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction ⁽¹³⁾	
Phthalate esters ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction	
Nitrosamines ^{(11), (14)}	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction 40 days after extraction	
PCBs ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C	7 days until extraction 40 days after extraction	
Nitroaromatics & Isophorone ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ ; store in dark	7 days until extraction 40 days after extraction	
Polynuclear Aromatic Hydrocarbons (PAHs) ^{(11),(14)}	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ ; store in dark	7 days until extraction 40 days after extraction	
Haloethers ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction 40 days after extraction	
Dioxin/Furan (TCDD/TCDF) ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction 40 days after extraction	

Subject NON-RADIOLOGICAL SAMPLE HANDLING	Number SA-6.1	Page 11 of 11
	Revision 3	Effective Date 02/04

ATTACHMENT B ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES PAGE THREE

(1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.

(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

(3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).

(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods and has received a variance from the Regional Administrator.

(5) Should only be used in the presence of residual chlorine.

(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.

(7) Samples should be filtered immediately on site before adding preservative for dissolved metals.

(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

(9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.

(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

- (11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
- (12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
- (13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- (14) For the analysis of diphenylnitrosamine, add 0.008% Na₂S₂O₃ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- (15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na₂S₂O₃.



STANDARD OPERATING PROCEDURES

Number	Page
SA-6.3	1 of 12
Effective Date	Revision
03/09/09	3

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Subject

FIELD DOCUMENTATION

Approved



TABLE OF CONTENTS

<u>SECTION</u> <u>PAGE</u>				
1.0	PURPOSE2			
2.0	SCOPE			
3.0	GLOSSARY2			
4.0	RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS2			
5.0	PROCEDURES2			
	5.1 SITE LOGBOOK 2 5.1.1 General 2 5.1.2 Photographs 3 5.2 FIELD NOTEBOOKS 3 5.3 FIELD FORMS 4 5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results. 4 5.3.2 Hydrogeological and Geotechnical Forms 5 5.3.3 Equipment Calibration and Maintenance Form 6 5.4 FIELD REPORTS 6 5.4.1 Daily Activities Report 7 5.4.2 Weekly Status Reports 7			
6.0	LISTING OF FIELD FORMS ON THE THUS INTRANET SITE7			
ATTAC A B C	SAMPLE LABEL10 CHAIN-OF-CUSTODY RECORD FORM11			

Subject	Number	Page
	SA-6.3	2 of 12
FIELD DOCUMENTATION	Revision 3	Effective Date 03/09/09

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs, and reports generally initiated and maintained for documenting Tetra Tech NUS, Inc. (TtNUS) field activities.

2.0 SCOPE

Documents presented within this SOP (or equivalents) shall be used for all TtNUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

<u>Project Manager (PM)</u> - The PM is responsible for obtaining hardbound controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

<u>Field Operations Leader (FOL)</u> - The FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

General personnel qualifications for field documentation activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather)
 conditions.
- Familiarity with appropriate procedures for documentation, handling, packaging, and shipping.

5.0 PROCEDURES

5.1 SITE LOGBOOK

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, record or reference the following activities/events (daily) in the site logbook:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration

Subject	Number	Page
	SA-6.3	3 of 12
FIELD DOCUMENTATION	Revision 3	Effective Date 03/09/09

- Start and/or completion of borehole, trench, monitoring well installation activities, etc.
- Daily on-site activities
- Sample pickup information
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving TtNUS or subcontractor personnel. Upon completion of the fieldwork, provide the site logbook to the PM or designee for inclusion in the project's central file.

Record the following information on the cover of each site logbook:

- Project name
- TtNUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2) but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, either record the measurements and equipment used in the site logbook or reference the field notebook in which the measurements are recorded (see Attachment A).

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the FOL at the end of each day.

5.1.2 Photographs

Sequentially number movies, slides, or photographs taken of a site or any monitoring location to correspond to logbook/notebook entries. Enter the name of the photographer, date, time, site location, site description, and weather conditions in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided because they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend on the subject matter, type of camera (digital or film), and the processing it requires. Follow chain-of-custody procedures for film used for aerial photography, confidential information, or criminal investigation. After processed, consecutively number the slides of photographic prints and label them according to the logbook/notebook descriptions. Docket the site photographs and associated negatives and/or digitally saved images to compact disks into the project's central file.

5.2 FIELD NOTEBOOKS

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a

Subject	Number	Page
	SA-6.3	4 of 12
FIELD DOCUMENTATION	Revision 3	Effective Date 03/09/09

separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 FIELD FORMS

All TtNUS field forms (see list in Section 6.0 of this SOP) can be found on the company's intranet site (http://intranet.ttnus.com) under Field Log Sheets. Forms may be altered or revised for project-specific needs, subject to client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOPs.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample log sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. Complete a sample log sheet for each sample obtained, including field quality control (QC) samples.

5.3.1.2 <u>Sample Label</u>

A typical sample label is illustrated in Attachment B. Complete the required information on the adhesive labels and apply them to every sample container. Obtain sample labels from the appropriate program/project source, request that they be electronically generated in house, or request them the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record

The chain-of-custody record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used as follows for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site:

- Retain one carbonless copy of the completed chain-of custody form in the field.
- Send one copy is sent to the PM (or designee)
- Send the original to the laboratory with the associated samples. Place the original (top, signed copy) of the chain-of custody form inside a large Ziploc®-type bag taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one chain-of custody form, send the form with the cooler containing vials for volatile organic compound (VOC) analysis or the cooler with the air bill attached. Indicate on the air bill how many coolers are included with that shipment.

An example of a chain-of-custody form is provided as Attachment C. After the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed chain-of custody form (any discrepancies between the sample labels and chain-of custody form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the TtNUS PM). The chain-of custody form is signed and copied. The laboratory will retain the copy, and the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment D is an example of a custody seal. The custody seal is an adhesive-backed label that is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. Sign and date custody seals

Subject	Number	Page
	SA-6.3	5 of 12
FIELD DOCUMENTATION	Revision	Effective Date
	3	03/09/09

and affix them across the lid and body of each cooler (front and back) containing environmental samples (see SOP SA-6.1). Obtain custody seals from the laboratory (if available) or purchase them from a supplier.

5.3.1.5 Geochemical Parameters Log Sheets

Complete Field Analytical Log Sheets to record geochemical and/or natural attenuation field test results.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

Complete a Groundwater Level Measurement Sheet for each round of water level measurements made at a site.

5.3.2.2 <u>Data Sheet for Pumping Test</u>

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. Use a Pumping Test Data Sheet to facilitate this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be established in advance.

5.3.2.3 Packer Test Report Form

Complete a Packer Test Report Form for each well at which a packer test is conducted.

5.3.2.4 Boring Log

Complete a Summary Log of Boring, or Boring Log for each soil boring performed to document the materials encountered, operation and driving of casing, and locations/depths of samples collected. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a photoionization detector [PID] or flame ionization detector [FID]), enter these readings on the boring log at the appropriate depth. When they become available, enter the laboratory sample number, concentrations of key contaminants, or other pertinent information in the "Remarks" column. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

Complete a Monitoring Well Construction Details Form for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

5.3.2.6 <u>Test Pit Log</u>

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible field geologist or sampling technician.

Subject	Number	Page
	SA-6.3	6 of 12
FIELD DOCUMENTATION	Revision	Effective Date
	3	03/09/09

5.3.2.7 <u>Miscellaneous Monitoring Well Forms</u>

Miscellaneous monitoring well forms that may be required on a project-specific basis include the Monitoring Well Materials Certificate of Conformance and Monitoring Well Development Record. Use a Monitoring Well Materials Certificate of Conformance to document all materials utilized during each monitoring well installation. Use a Monitoring Well Development Record to document all well development activities.

5.3.2.8 Miscellaneous Field Forms – Quality Assurance and Checklists

Miscellaneous field forms/checklists forms that may be required on a project-specific basis include the following:

- Container Sample and Inspection Sheet use this form when a container (drum, tank, etc.) is sampled and/or inspected.
- QA Sample Log Sheet use this form when a QA sample such as an equipment rinsate blank, source blank, etc. is collected.
- Field Task Modification Request (FTMR) use this form to document deviations from the project planning documents. The FOL is responsible for initiating the FTMRs. Maintain copies of all FTMRs with the on-site planning documents, and place originals in the final evidence file.
- Field Project Daily Activities Checklist and Field Project Pre-Mobilization Checklist used these during both the planning and field effort to ensure that all necessary tasks are planned for and completed. These two forms are not requirements but are useful tools for most field work.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log, which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. Maintain an Equipment Calibration Log for each electronic measuring device used in the field; make entries for each day the equipment is used or in accordance with manufacturer recommendations.

5.4 <u>FIELD REPORTS</u>

The primary means of recording on-site activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation but are not easily used for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain on site for extended periods of time and are thus not accessible for timely review by project management. Other reports useful for tracking and reporting the progress of field activities are described below.

Subject	Number	Page
	SA-6.3	7 of 12
FIELD DOCUMENTATION	Revision	Effective Date
	3	03/09/09

5.4.1 Daily Activities Report

To provide timely oversight of on-site contractors, complete and submit Daily Activities Reports (DARs) as described below.

5.4.1.1 Description

The DAR documents the activities and progress for each day's field work. Complete this report on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring that involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the TtNUS intranet site.

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the DAR to the FOL for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DARs are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the PM.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

In addition to those described herein, other summary reports may also be contractually required.

All TtNUS field forms can be found on the company's intranet site at http://intranet.ttnus.com under Field Log Sheets.

6.0 LISTING OF FIELD FORMS ON THE TINUS INTRANET SITE

- Boring Log
- Container Sample and Inspection Sheet
- Daily Activities Checklist
- Daily Activities Record
- Equipment Calibration Log
- Field Task Modification Request
- Field Analytical Log sheet Geochemical Parameters
- Groundwater Level Measurement Sheet
- Groundwater Sample Log Sheet
- Hydraulic Conductivity Test Data Sheet
- Low Flow Purge Data Sheet
- Bedrock Monitoring Well Construction (Stick Up)
- Bedrock Monitoring Well Construction Flush Mount
- Bedrock Monitoring Well Construction Open Hole
- Confining Layer Monitoring Well Construction
- Monitoring Well Development Record

Subject	Number SA-6.3	Page 8 of 12
FIELD DOCUMENTATION	Revision 3	Effective Date 03/09/09

- Monitoring Well Materials Certificate of Conformance
- Overburden Monitoring Well Construction Flush Mount
- Overburden Monitoring Well Construction Stick Up
- Packer Test Report Form
- Pumping Test Data Sheet
- QA Sample Log Sheet
- Soil/Sediment Sample Log Sheet
- Surface Water Sample Log Sheet
- Test Pit Log
- Field Project Pre-Mobilization Checklist

Subject	Number	Page
	SA-6.3	9 of 12
FIELD DOCUMENTATION	Revision	Effective Date
	3	03/09/09

ATTACHMENT A TYPICAL SITE LOGBOOK ENTRY

START TIME:		DATE:	_
SITE LEA	DER:		
PERSON	NEL: TtNUS	DRILLER	SITE VISITORS
WEATHE	R: Clear, 68°F, 2-5 mph w	ind from SE	
ACTIVITIE	ES:		
1.	Steam jenney and fire ho	oses were set up.	
2.	Geologist's Notebook, N S4 collected; see samp	ell resumes. Rig geologist to 1, page 29-30, for details of drilling le logbook, page 42. Drilling activitiell installed. See Geologist's Note rell	ng activity. Sample No. 123-21- ities completed at 11:50 and a
3.	3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well		
4.	Well drilled. Rig geologist was See Geologist's Notebook, No. 2, page for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.		
5.	 Well was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free." 		
6.	EPA remedial project ma	inger arrives on site at 14:25 hours.	
7.	Large dump truck arrive over test pit	s at 14:45 and is steam-cleaned. E	Backhoe and dump truck set up
8.	8. Test pit dug with cuttings placed in dump truck. Rig geologist was See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit resulted in a very soft and wet area. A mound was developed and the area roped off.		
9.		up samples (see Sample Logb es terminated at 18:22 hours. All pe	
		Field Operations Leader	

Subject	Number	Page
	SA-6.3	10 of 12
FIELD DOCUMENTATION	Revision	Effective Date
	3	03/09/09

ATTACHMENT B SAMPLE LABEL

TŁ	Tetra Tech NUS 661 Andersen I Pittsburgh, 152 (412)921-7090	Orive	Project: Site: Location:	
Sample N	lo:			Matrix:
Date:	Ti	me:	Preserve	e:
Analysis	•			
Sampled	by:		Laborato	ory:

Tei	
etra Tech l	
ch NUS,	
is, Inc.	
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PROJECT NO: FACILITY: SAMPLERS (SIGNATURE)			PROJECT MANAGER FIELD OPERATIONS LEADER		PHONE NUMBER PHONE NUMBER				PAGE OF LABORATORY NAME AND CONTACT: ADDRESS]]				
	*				NUMBER				ŀ	CITY, ST						COME	CUME	
	72 hr. 7 day 14 day	тор обртн (FT)	ВОТТОМ DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAP (G) COMP (C)	P U:	ONTAINER LASTIC (P) RESERVAT SED	or GLA	SS (G)						ATTACHMENT C CHAIN-OF-CUSTODY RECORD FORM	TIELU DOCUMENTATION	_	
Y LIME	SAMPLE ID O	TOP	ВОТ	MAT	GRA	Š		/	/	/	/			COMMENTS	ATTACHMENT C	Revision		
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Subject	Number SA-6.3	Page 12 of 12
FIELD DOCUMENTATION	Revision 3	Effective Date 03/09/09

ATTACHMENT D CHAIN-OF-CUSTODY SEAL

USTODY SEAL
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STANDARD OPERATING PROCEDURES

Number	Page
SA-7.1	1 of 16
Effective Date	Revision
01/28/2009	6

Applicability

Tetra Tech NUS, Inc.

Prepared

Earth Sciences Department

Subject DECONTAMINATION OF FIELD EQUIPMENT

Approved

Tom Johnston

TABLE OF CONTENTS

SECT	<u> </u>	1	PAGE					
1.0	PURPO	SE	2					
2.0	SCOPE	SCOPE AND APPLICABILITY2						
3.0	GLOSS	GLOSSARY2						
4.0	RESPO	RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS						
5.0	HEALTH AND SAFETY3							
6.0	EQUIPN	MENT LIST	3					
7.0	PROCE	DURES	4					
	7.1	Decontamination Pad Design/Construction Considerations						
	7.1.1 7.1.2	Temporary Decontamination Pads Decontamination Activities at Drill Rigs/DPT Units						
	7.1.2 7.1.3	Decontamination Activities at Remote Sample Locations						
	7.1.3 7.2	Equipment Decontamination Procedures						
	7.2.1	Monitoring Well Sampling Equipment						
	7.2.2	Downhole Drilling Equipment						
	7.2.3	Soil/Sediment Sampling Equipment						
	7.3	Contact Waste/Materials	11					
	7.3.1	Investigation-Derived Wastes - Decontamination Wash Waters and Sediments						
	7.4	Decontamination Evaluation	13					
ATTA	ACHMENTS	-						
	Α	INVESTIGATION-DERIVED WASTE LABEL	15					

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 2 of 16
	Revision 6	Effective Date 01/28/2009

1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The purpose of this Standard Operating Procedure (SOP) is to protect site personnel, the general public, and the environment while preserving or maintaining sample integrity. It is further intended through this procedure to describe the steps necessary for proper decontamination of drilling equipment, earth-moving equipment, chemical sampling equipment and field operation and analytical equipment.

2.0 SCOPE AND APPLICABILITY

This procedure applies to all equipment used to provide access to/acquire environmental samples that may have become contaminated through direct contact with contaminated media including air, water, and soil. This equipment includes drilling and heavy equipment and chemical sampling and field analytical equipment. Where technologically and economically feasible, single-use sealed disposable equipment will be employed to minimize the potential for cross-contamination. This SOP also provides general reference information on the control of contaminated materials.

Decontamination methods and equipment requirements may differ from one project to another. General equipment items are specified in Section 6.0, but project-specific equipment must be obtained to address the project-specific decontamination procedures presented in Section 7.0 and applicable subsections.

3.0 GLOSSARY

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

<u>Decontamination Solution</u> - A solution selected/identified in the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

<u>Deionized Water (DI)</u> - Tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet College of American Pathologists (CAP) and National Committee for Clinical Laboratory Standards (NCCLS) specifications for reagent-grade Type I water.

<u>Potable Water</u> - Tap water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

<u>Pressure Washing</u> - Process employing a high-pressure pump and nozzle configuration to create a high-pressure spray of potable water. High-pressure spray is employed to remove solids from equipment.

<u>Solvent</u> – A liquid in which solid chemicals or other liquids are dissolved. The solvent of choice is pesticide-grade isopropanol. Use of other solvents (methanol, acetone, or hexane) may be required for particular projects or for a particular purpose (e.g., removal of concentrated waste) and must be justified in the project planning documents. For example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

<u>Steam Pressure Washing</u> - A cleaning method employing a high-pressure spray of heated potable water to remove various organic/inorganic chemicals from equipment.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 3 of 16
	Revision 6	Effective Date 01/28/2009

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

<u>Project Manager</u> - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

<u>Decontamination Personnel</u> - Individuals assigned the task of decontamination. It is the responsibility of these individuals to understand the use and application of the decontamination process and solutions as well as the monitoring of that process to ensure that it is working properly. This is accomplished through visual evaluation, monitoring instrument scanning of decontaminated items, and/or through the collection of rinsate blanks to verify contaminant removal.

<u>Field Operations Leader (FOL)</u> - Responsible for the implementation of project-specific planning documents. This includes on-site verification that all field activities are performed in compliance with approved SOPs or as otherwise dictated by the approved project plan(s). The FOL is also responsible for the completion and accuracy of all field documentation.

<u>Site Safety Officer (SSO)</u> - Exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on site (as part of the equipment inspection), leaving the site, and moving between locations is required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Improper or incomplete decontamination is sufficient to restrict equipment from entering the site, exiting the site, or moving to a new location on the site until the objectives are successfully completed.

General personnel qualifications for decontamination activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather)
 conditions.
- Familiarity with appropriate decontamination procedures.

5.0 HEALTH AND SAFETY

In addition to the health and safety issues and reminders specified in subsections of this SOP, the following considerations and requirements must be observed as SOPs for field equipment decontamination activities:

- If any solvents or hazardous chemicals (e.g., isopropyl alcohol) are to be used in equipment decontamination activities, the FOL must first obtain the manufacturer's/supplier's Material Safety Data Sheet (MSDS) and assure that it is reviewed by all users (prior to its use), added to the site Hazardous Chemical Inventory, and maintained on site as part of the project Hazard Communication Program.
- Review and observe specific health and safety requirements (e.g., personal protective equipment [PPE]) specified in the project-specific health and safety plan for this activity.

6.0 EQUIPMENT LIST

Wood for decontamination pad construction, when applicable (see Section 7.1).

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 4 of 16
	Revision 6	Effective Date 01/28/2009

- Tools for constructing decontamination pad frame, when applicable (see Section 7.1).
- Visqueen sheeting or comparable material to cover decontamination pad frame, when applicable (see Section 7.1).
- Wash/drying racks for auger flights and drill/drive rods, when applicable (see Section 7.2).
- PPE as specified in the project health and safety plan.
- Soap and water for washing and rinsing.
- Deionized water for final rinsing.
- Solvents (e.g., pesticide-grade isopropanol) for rinsing (see applicable portions of Section 7.2).
- Tubs, buckets, etc. for containerizing rinse water (see applicable portions of Section 7.2).
- Sample bottles for collecting rinsate blanks (see Section 7.2).
- Calibrated photoionization detector (PID) or flame ionization detector (FID) to monitor decontaminated equipment for organic vapors generated through the existence of residual contamination or the presence of decontamination solvent remaining after the piece was rinsed.
- Aluminum foil or clear clean plastic bag for covering cleaned equipment (see applicable portions of Section 7.2).
- Paper towels or cloths for wiping.
- Brushes, scrapers, or other hand tools useful for removing solid materials from equipment.
- Clear plastic wrap for covering or wrapping large decontaminated equipment items (see Section 7.2.2).
- Drum-moving equipment for moving filled waste drums (optional) (see Section 7.3).
- Drum labels for waste drums (see Attachment A).

7.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or isolation of contaminants. To accomplish this activity, preparation is required including site preparation, equipment selection, and evaluation of the decontamination requirements and processes. Site contaminant types, concentrations, and media types are primary drivers in the selection of the types of decontamination and where it will be conducted. For purposes of this SOP, discussion is limited to decontamination procedures for general environmental investigations.

Decontamination processes will be performed at the location(s) specified in project-specific planning documents. Typical decontamination locations include the following:

- Temporary decontamination pads/facilities
- Sample locations
- Centralized decontamination pad/facilities

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 5 of 16
	Revision 6	Effective Date 01/28/2009

Combination of some or all of the above

The following discussion includes general considerations for the decontamination process. Specific construction and implementation procedures will be as specified in the project-specific planning documents and/or may be as dictated by site-specific conditions as long as the intent of the requirements in the planning documents is met. This intent is to contain any residual fluids and solids generated through the decontamination process.

7.1 <u>Decontamination Pad Design/Construction Considerations</u>

7.1.1 Temporary Decontamination Pads

Temporary decontamination pads may be constructed at satellite locations within the site area in support of temporary work areas. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth-moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations:

- Site location The decontamination site selected should be far enough from the work site to maximize decontamination effectiveness while minimizing travel distance. The location of the decontamination site shall be selected to provide, in the judgment of the FOL or FOL designee, compliance with as many of the following characteristics as practicable:
 - Well removed from pedestrian/vehicle thoroughfares.
 - Avoidance of areas where control/custody cannot be maintained.
 - Avoidance of areas where potential releases of contaminated media or decontamination fluids may be compounded through access to storm water transport systems, streams, or other potentially sensitive areas.
 - Avoidance of potentially contaminated areas.
 - Avoidance of areas too close to the ongoing operation, where cross-contamination may occur.

The selected decontamination site should include the following, where possible:

- Areas where potable water and electricity are provided.

Safety Reminder

When utilizing electrical power sources, either hard-wired or portable-generated sources, ensure that:

- All power is routed through a Ground Fault Circuit Interrupter (GFCI).
- All power cords are in good condition (no physical damage), rated for the intended energy load, and designated for outdoor use.

In situations where accomplishing these elements is not possible, it will be necessary to implement a site electrical grounding program.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 6 of 16
	Revision 6	Effective Date 01/28/2009

- Areas where support activities such as removing decontamination waters soil and sediment are possible without entering an active exclusion zone.
- Areas that offer sufficient size to carry out the specific decontamination sequence.
- Decontamination pad (decon pad) The decon pad shall be constructed to meet the following characteristics:
 - Size The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination. The size should permit these movements utilizing pressure/steam washer wands and hoses and minimizing splash due to work in close quarters.
 - Slope An adequate slope will be constructed to permit the collection of water and potentially contaminated soil within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. Because the pad will be sloped, place a light coating of sand over the plastic to minimize potential slips and falls. See the text about liners below.
 - Sidewalls The sidewalls shall be at least 6 inches in height (or as high as possible if 6 inches is not achievable) to provide adequate containment for wash waters and soil. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls may be constructed of wood, inflatables, sand bags, etc. to permit containment. Splash guards are typically wood frames with Visqueen coverings to control overspray.
 - Liner Depending on the types of equipment and decontamination method to be used, the liner should be of sufficient thickness to provide a puncture-resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. The desired thickness may be achieved through layering materials of lighter construction. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner, a light coating of sand shall be applied to provide traction as necessary.
 - Wash/drying racks Auger flights, drill/drive rods, and similar equipment require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process.

For decontamination of direct-push technology (DPT) equipment, the pad may be as simple as a mortar tub containing buckets of soapy water for washing and an empty bucket to capture rinse waters. Decontamination may be conducted at the rear of the rig to permit rapid tool exchange.

- Maintenance Maintain the decontamination area by:
 - Periodically clearing the work area of standing water, soil, and debris, and coiling hoses to aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross-contamination.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 7 of 16
	Revision 6	Effective Date 01/28/2009

- Regularly changing the decontamination fluids to ensure proper cleaning and prevent cross-contamination.
- PPE Periodically evaluate the condition of, and maintain the decontamination equipment, including regular cleaning of face shields and safety glasses. This is critical to ensuring the safety of decontamination personnel and the integrity of the decontamination process, and it will ensure that equipment is functioning properly.

7.1.2 Decontamination Activities at Drill Rigs/DPT Units

During subsurface sampling activities including drilling and DPT activities, decontamination of drive rods, Macro Core Samplers, split spoons, etc. is typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected environmental media. Drying racks shall be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/reuse. Methodology regarding this activity is provided in Section 7.2.

7.1.3 Decontamination Activities at Remote Sample Locations

When sampling at remote locations, sampling equipment such as trowels and pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition. Flushing and cleaning of single-use equipment such as disposable trowels, tubing, and surgeon's gloves may allow disposal of this equipment after visible soil and water remnants have been removed.

7.2 <u>Equipment Decontamination Procedures</u>

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

7.2.1 Monitoring Well Sampling Equipment

- 7.2.1.1 <u>Groundwater sampling equipment This includes pumps inserted into monitoring wells such as bladder pumps, Whale pumps, and Redi-Flo pumps and reusable bailers, etc.</u>
- 1. Evacuate to the extent possible, any purge water within the pump/bailer.
- 2. Scrub using soap and water and/or steam clean the outside of the pump/bailer and, if applicable, the pump tubing.
- 3. Insert the pump and tubing/bailer into a clean container of soapy water. Pump/run a sufficient amount of soapy water through the pump/bailer to flush out any residual well water. After the pump is flushed, circulate soapy water through the pump to ensure that the internal components are thoroughly flushed.
- 4. Remove the pump and tubing/bailer from the container
- 5. Rinse external pump components using tap water.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 8 of 16
	Revision 6	Effective Date 01/28/2009

6. Insert the pump and tubing/bailer into a clean container of tap water. Pump/run a sufficient amount of tap water through the pump/bailer to evacuate all of the soapy water (until clear).

CAUTION

Do not rinse PE, PVC, and associated tubing with solvents –
Use the procedures defined in the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 7 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

- 7. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment to be cleaned with pesticide-grade isopropanol.
- 8. Pass deionized water through the hose to flush out the tap water and solvent residue as applicable.
- 9. Drain residual deionized water to the extent possible.
- 10. Allow components of the equipment to air dry.
- 11. For bladder pumps, disassemble the pump and wash the internal components with soap and water, then rinse with tap water, isopropanol, and deionized water and allow to dry. After the parts are dry, conduct a visual inspection and a monitoring instrument scan to ensure that potential contaminants and all decontamination solvent have been removed. Collect a rinsate blank in accordance with the project-specific planning documents to ensure that the decontamination process is functioning as intended. The typical frequency of collection for rinsate blanks is 1 per 20 field samples. In addition, wipe samples or field tests such as UV light may be used.
- 12. Wrap pump/bailer in aluminum foil or a clear clean plastic bag for storage.

SAFETY REMINDER

Remember when handling powered equipment to disconnect the power source and render the equipment to a zero energy state (both potential and kinetic) before opening valves, disconnecting lines, etc.

7.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing the extracted tape and probe with deionized water and wiping the surface of the extracted tape between locations is acceptable. However, periodic full decontamination should be conducted as follows:

- 1. Wash with soap and water
- 2. Rinse with tap water
- 3. Rinse with deionized water

NOTE

In situations where oil, grease, free product, other hard to remove materials are encountered, probes and exposed tapes should be washed in hot soapy water. If probes or tapes cannot be satisfactorily decontaminated (they are still stained, discolored, etc.), they should be removed from service.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 9 of 16
	Revision 6	Effective Date 01/28/2009

7.2.1.3 <u>Miscellaneous Equipment</u>

Miscellaneous equipment including analytical equipment (water quality testing equipment) shall be cleaned per manufacturers' instructions. This generally includes wiping the sensor housing and rinsing with tap and deionized water.

Coolers/shipping containers employed to ship samples are received from the laboratory in a variety of conditions including marginal to extremely poor. Coolers shall be evaluated prior to use for the following:

- Structural integrity Coolers missing handles or having breaks in the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples in the cooler(s) provided is too great and request a replacement unit.
- Cleanliness As per protocol, only volatile organic samples are accompanied by a trip blank. If a
 cooler's cleanliness is in question (visibly dirty/stained) or if there are noticeable odors, the cooler
 should be decontaminated prior to use as follows:
 - 1. Wash with soap and water
 - 2. Rinse with tap water
 - 3. Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and ask the cooler provider (e.g., the analytical laboratory) to provide a replacement unit.

7.2.2 Downhole Drilling Equipment

This includes any portion of the drill rig that is over the borehole, including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. The following procedure is to be employed prior to initiating the drilling/sampling activity, then between locations:

CAUTION

Exercise care when using scrapers to remove soil and debris from downhole drilling equipment. Inadvertent slips of scrapers have resulted in cuts, scrapes, and injured knuckles, so use scrapers carefully when removing soil from these items.

- 1. Remove loose soil using shovels, scrapers, etc.
- 2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment being decontaminated.

CAUTION

In Step 3, do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

3. Rinse the equipment with tap water, where applicable (steam cleaning and pressure washing incorporate rinsing as part of the process).

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 10 of 16
	Revision 6	Effective Date 01/28/2009

- 4. If the equipment has directly or indirectly contacted contaminated sample media and is known or suspected of being contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse equipment with pesticide-grade isopropanol
- 5. To the extent possible, allow components to air dry.
- If the decontaminated equipment is to be used immediately after decontamination, screen it with a
 calibrated photoionization detector (PID)/flame ionization detector (FID) to ensure that all
 contaminants and possible decontamination solvents (if they were used) have been adequately
 removed.
- 7. Wrap or cover equipment in clear plastic until it is time to be used.

SAFETY REMINDER

Even when equipment is disconnected from power sources, dangers such as the following may persist:

- <u>Falls</u> An auger flight standing on its end may fall and injure someone. Secure all loose articles to prevent heavy articles from falling onto people or equipment.
- <u>Burns</u> Steam cleaner water is heated to more than 212 °F and exhibits thermal energy that can cause burns. Prevent contact of skin with hot water or surfaces.

<u>High water pressure</u> - Pressure washer discharge can have 2,000 to 4,000 psi of water pressure. Water under this amount of pressure can rupture skin and other human tissues. Water at 4,000 psi exiting a 0° tip can be dangerous because of its relatively high cutting power. The exit velocity and cutting power of the water are reduced when exiting a 40° fan tip, but damage to soft tissues is still possible.

In general, follow the rules below to avoid injury, equipment damage, or incomplete decontamination:

- 1. Read the operating manual and follow the manufacturers' recommended safety practices before operating pressure washers and steam cleaners.
- Never point the pressure washer or steam cleaner at another person or use to clean your boots or other parts of your body. Water lacerations and burns may appear to be minor at first but can be life threatening. Do not attempt to hold small parts in your hand while washing them with hightemperature or high-pressure water.
- 3. Always wear PPE as specified in the HASP such as:
 - Hard hat, safety glasses, splash shield, impermeable apron or splash suit, and hearing protection. Remember that excessive noise is a hazard when operating gas-powered engines and electrically driven pressure washers. PPE will be identified in your project specific planning documents.
- 4. Inspect each device before use. An inspection checklist will be provided in the project-specific planning documents. If it is a rented device, safety measures are typically provided by the vendor. In all cases, if you are not familiar with the operation of a pressure washer/steam cleaner, do not operate it until you obtain and thoroughly review operating instructions and recommended safety practices.
- 5. Do not modify equipment unless the manufacturer has approved the modifications.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 11 of 16
	Revision 6	Effective Date 01/28/2009

7.2.3 Soil/Sediment Sampling Equipment

This section applies to soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

- 1. Remove all loose soil from the equipment through manual means.
- 2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment.
- 3. Rinse the equipment with tap water.

CAUTION

Do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

- 4. If the equipment is contaminated or suspected to be contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment with pesticide-grade isopropanol.
- 5. Rinse the equipment with deionized water.
- 6. To the extent possible, allow components to air dry.
- 7. If the equipment is to be used immediately after decontamination, screen it with a calibrated PID/FID to ensure that all solvents (if they were used) and trace contaminants have been adequately removed.
- 8. After the equipment has dried, wrap it in aluminum foil for storage until use.

Dredges employed in sediment sampling are typically decontaminated as follows:

- Remove the sediment sample from the sampling device
- If sufficient associated surface water is available at the sampling site, place the dredge in the water and flush to remove visible sediment.
- Extract the dredge and wash it in soap and water per the project-specific planning documents.

CAUTION

When handling dredges, the primary safety concern is trapping fingers or extremities in the larger dredge samplers within the jaws or pinch points of the mechanical jaws. Keep hands, fingers, and extremities away from these pinch and compression points. Either handle the device by the rope or preferably lock the jaws in place to control the potential for closing during maintenance and/or cleaning.

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 12 of 16
	Revision 6	Effective Date 01/28/2009

7.3 Contact Waste/Materials

During the course of field investigations, disposable/single-use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.), and broken sample containers.

With the exception of the broken glass, single-use articles should be cleaned (washed and rinsed) of visible materials and disposed as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned shall be containerized for disposal in accordance with applicable federal, state, and local regulations.

7.3.1 Investigation-Derived Wastes - Decontamination Wash Waters and Sediments

NOTE

Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage areas will be provided in project-specific documents, or separate direction will be provided by the Project Manager.

- Assume that all investigation-derived waste (IDW) generated from decontamination activities contains
 the hazardous chemicals associated with the site unless there are analytical or other data to the
 contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases
 where large equipment required cleaning.
- 2. Where possible, use filtering systems to extend the use of water within a closed system wash unit to recycle water and to reduce possible waste amounts.

NOTE

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.

- 3. Label waste storage containers appropriately labeled (see Attachment A).
- 4. Ensure that the IDW storage area is configured to meet the following specifications to permit access to the containers and to conduct spill/leak monitoring, sampling, and extraction when the disposal route is determined:
 - Enclose areas accessible by the general public using construction fencing and signs.
 - Stored materials in 55-gallon drums on pallets with four (or fewer) drums per pallet.
 - Maintain the retaining bolt and label on the outside of storage containers where readily visible.
 - Provide at least 4 feet of room between each row of pallets to allow access to containers for sampling, drum removal, and spill response.
 - As directed in project-specific planning documents, maintain an IDW Inventory List and provide the list to the site Point of Contact at the termination of each shift.
 - Maintain spill response equipment at the IDW storage area in case it is required for immediate access.

Subject	DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 13 of 16
		Revision 6	Effective Date 01/28/2009
	 Where possible, use equipment manipulate containers. 	for moving containers. Where no	t possible, obtain help to

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 14 of 16
	Revision 6	Effective Date 01/28/2009

CAUTION

Each container of water can weigh up to 490 pounds. Each 55-gallon drum of wet soil can weigh more than 750 pounds. Fill drums and temporary containers to 80 percent capacity to minimize spill and handling difficulties. Use drum carts to move filled drums.

See safe lifting techniques provided in Section 4.4 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual.

When placing drums, keep your fingers out of pinch and smash points such as between the drums. In some cases such as well development and/or purge water, you can place the drums to be filled on the pallet and transport materials in smaller easier to handle containers.

7.4 <u>Decontamination Evaluation</u>

Upon decontamination of equipment, determine the effectiveness of the decontamination process in the following manner:

- Visual evaluation A visual evaluation will be conducted to ensure the removal of particulate matter. This shall be done to ensure that the washing/rinsing process is working as intended.
- Instrument Screening A properly calibrated PID/FID should be used to evaluate the presence of site contaminants and solvents used in the cleaning process. The air intake of the instrument shall be passed over the article to be evaluated. Avoid placing the instrument probe into residual waters. A PID/FID reading greater than the daily established background level requires a repeat of the decontamination process, followed by rescreening with the PID/FID. This sequence must be repeated until no instrument readings greater than the daily established background level are observed. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instrument's capabilities.

NOTE

When required by project-specific planning documents, collection of rinsate blanks (see next step) shall be completed without exception unless approval to not collect these samples is obtained from the Project Manager.

- Collection of Rinsate Blanks It is recommended that rinsate samples be collected to:
 - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.
 - Single-use disposable equipment The number of samples should represent different types of equipment as well as different lot numbers of single-use articles.
 - The collection and the frequency of collection of rinsate samples are as follows unless specified differently in the project-specific planning documents:
 - Per decontamination method
 - Per disposable article/batch number of disposable articles

Subject DECONTAMINATION OF FIELD EQUIPMENT	Number SA-7.1	Page 15 of 16
	Revision 6	Effective Date 01/28/2009

NOTE

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and to avoid using a contaminated batch of single-use articles. It is recommended that a follow-up sample be collected later during the execution of the project to ensure that those conditions do not change.

Rinsate samples collection may be driven by types of and/or levels of contaminant. Difficult to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.



OPERATING

Effective Date 01/28/2009

Applicability
Tetra Tech NUS,

Earth Sciences Department

Tom Johnston

DECONTAMINATION OF FIELD EQUIPMENT

Attachment A iDW Label

INVESTIGATION DERIVED WASTE GENERATOR INFORMATION:

SITE _____ JOB NO. ____

LOCATION ____

DATE _____

CONTENTS _____

CONTACT ____

VOLUME _____

EMERGENCY PHONE NUMBER _____

Tetra Tech

PROJECT:	LOCATION:	
	MOBILIZATION DATE:	
	RETURN DATE:	
FIELD PROJECT PRE-M	OBILIZATION CHECKLIST	
TRAVEL	MISCELLANEOUS	
Airline reservations Hotel reservations/BOQs Vehicle rental Itinerary Phone/pager number DRILLING/DPT/SURVEY Subcontractor POC phone #/address Drill Specification RFP	Schedule Plan field operations w/ Project manager Documents for Field Program Logbook(s) Field Sampling plan Health & Safety plan Maps H & S Guidance Manual Authorization	
Contact (time & place to meet) Confirm subcontract w/ TtNUS Procurement Health and Safety documentation for all personnel on site Copy of Drillers license Well / boring permits	 Kick-off meeting held Gov't rate letter H&S/OSHA 40-hour certifcate 8-Hour Refresher Training Certificate Medical Clearance Letter Supervisory Training Certificate Health & Safety Clearance Letter 	
Utilities (2 weeks lead time) Contact Site POC (Date:)	Full-size OSHA Poster HYDROGEOLOGY EQUIPMENT	
Contact Local "Call Before You Dig" Utility Clearance Form Forms Boring logs / Test Pit logs Well construction / development forms Daily activity forms	 Slug test/pumping test forms Groundwater elevation data sheets Graph paper Data Logger/transducer/data cable Existing well construction & water level data M-Scope, slug 	
IDW inventory	SHIPPING	
IDW drum labels Chemical Inventory MSDS's EQUIPMENT MOBILIZATION Equipment Requisition form completed / equipment ordered 3rd Party rental / misc. equipment ordered Equipment calibration forms Span / calibration gas and regulator	Forms FedEx Airbills, local dropoff location & hours FedEx Gov. Acct# (1771-8058-0) Lab Shipping Labels Warehouse Shipping Labels Blank Labels Supplies Tape Packing materials	
SAMPLING	Baggies, Large garbage bags	
Forms Sample log sheets Low-flow purge data sheets COC records COC seals Sample labels (from database group) Laboratory POC address/phone# Order bottles / preservatives Shipping address, also check Sat. address Bottle & preservation req'ts from lab	OTHER Site POC name/phone # Personnel information to POC Mobilization schedule to POC Site access authorizations Field office / trailer arrangements made Electric, phone hookups arranged Steel-toed boots, safety glasses, & hard hat First aid equipment Insect repellent	

Tetra Tech

PROJECT:		JOB #:			
LOCATION:		DATE:			
PROJECT MANAGER:	FOL:_				
DAILY ACTIVITI	ES CHE	CKLIST			
Startup (Checklist				
Activity			Yes	No	N/A
Pertinent site activities/information entered into site logbook					
All onsite personnel listed in logbook					
Required medical information onsite for all workers (Tetra Te	ch and Subc	contractors)			
Required MSDS's onsite					
Proper equipment calibrations performed (list equipment)					
1					
2					
3					
4					
Calibration logs filled out					
Required work permits filled out/signed					
Required utility clearances obtained					
Required PPE onsite and in use					
Information required to be posted is in place	. \				
(OSHA poster, hospital route, key phone numbers, e	etc.)				
Fyit Ch	necklist				
	icokiist				
Activity			Yes	No	N/A
Logbooks completely and comprehensively filled out					
Samples properly packaged/shipped					
COCs faxed to appropriate in-house personnel					
All equipment accounted for, on charge if needed, and prope	rly secured				
All personnel accounted for					
Arrangements made for upcoming work (permits, clearances	, equipment,	, etc.)			
Site properly secured					

Note - not all items listed apply to every job, and some additional requirements may apply on a job-specific basis.

	tra Tech
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DAILY ACTIVITIES RECORD

PROJECT NAME: CLIENT: DATE: Tt PERSONNEL: CONTRACTOR:			PROJECT NUMBER: LOCATION: ARRIVAL TIME: DEPARTURE TIME: DRILLER:	
ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE
	l l	I	I	I

APPROVED BY:

COMMENTS:

TETRA TECH REPRESENTATIVE

DRILLER

DATE:



EQUIPMENT CALIBRATION LOG

PROJECT NAME :	INSTRUMENT NAME/MODEL:
SITE NAME:	MANUFACTURER:
PROJECT No.:	SERIAL NUMBER:

Date	Instrument	Person	Instrumen	t Settings	Instrument	Readings	Calibration	Remarks
of	I.D.	Performing	Pre-	Post-	Pre-	Post-	Standard	and
Calibration	Number	Calibration	calibration	calibration	calibration	calibration	(Lot No.)	Comments
							, , , , , , , , , , , , , , , , , , ,	
	<u>-</u>			<u>-</u>				

Æ	Tetra	a Tech		<u>BC</u>	ORING LOG		Pag	e _	(of _	
PROJECT PROJECT DRILLING DRILLING	T NUMI G COMI	BER:		 <u> </u>	BORING NO DATE: GEOLOGIS DRILLER:	•			<u>—</u>	<u>—</u>	
Sample Depth No. (Ft.) and or Type Run or RQD No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	(Depth/Ft.)		RIAL DESCRIPTION Material Classification	U s c s *	Remarks	Sample Sample	Sampler BZ Basa d	Borehole**	Driller BZ** dd

					M	IATEF	RIAL DESCRIPTION			PID/FI	D Rea	iding ((ppm)
Sample No. and Type or RQD	(Ft.) or Run	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	り の ひ の *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**
		/_											
													-
		//											

^{*} When rock coring, enter rock brokeness.

** Include monitor reading in 6	foot intervals @ boreh	ole. Increase reading frequen	cy if elevated reponse read.	Drilling Area	
Remarks:				Background (ppm):	
			_		
Converted to Well:	Yes	No	Well I.D. #:		



SOIL & SEDIMENT SAMPLE LOG SHEET

					Page	e of
Project Site Nam Project No.: [] Surface Soi [] Subsurface [] Sediment [] Other: [] QA Sample	il Soil				ocation: By:	
GRAB SAMPLE DATA	4					
Date:		Depth Interval	Color	Description	(Sand, Silt, Clay, Moi	sture, etc.)
Time:					,	
Method:						
Monitor Reading (ppm)						
COMPOSITE SAMPLE	DATA:					
Date:	Time	Depth Interval	Color	Description	(Sand, Silt, Clay, Moi	sture, etc.)
Method:						
Monitor Readings						
(Range in ppm):						
(Hange in ppin).						
		⇒ ≥ 0 ≥ 1,11,11,11,11,11,11,11,11,11,11,11,11,1	*************************			
SAMPLE COLLECTION	NINFORMAI	ION:				
*************************			Carataines Beau		Oallantod	Othor
(31, 11, 11, 11, 11, 11, 11, 13, 13, 11, 11	Analysis		Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
			Container Requ	irements	Collected	Other
	Analysis		Container Requ		Collected	Other
OBSERVATIONS / NO	Analysis		Container Requ	MAP	Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
	Analysis		Container Requ		Collected	Other
OBSERVATIONS /: NO	Analysis		Container Requ	MAP	Collected	Other
	Analysis		Container Requ		Collected	Other



QA SAMPLE LOG SHEET

Page___ of ___

Project Site Name: Project Number: Sample Location: QA Sample Type:	[] Trip Blank [] Source Water Blank	Sample ID Number: Sampled By: C.O.C. Number: [] Rinsate Blank [] Other Blank	
SAMPLING DATA:		WATER SOURCE:	
Date: Time: Method:		[] Laboratory Prepared [] Tap [] Purchased [] Fire Hydrant [] Other	
	TER INFORMATION irce or Rinsate Water):	RINSATE INFORMATION (If Applicable):	
Manufacturor:		Media Type: Equipment Used: Equipment Type: [] Dedicated [] Reusable	_
SAMPLE COLLECTION	INFORMATION:		
Analysis	Preservative	Container Requirements Collect	
Volatiles	Cool 4°C & HCl	YES /	
Semivolatiles	Cool 4°C	YES /	
	Cool 4°C	YES /	NO
Pesticide / PCB			
Metals	Cool 4°C & HNO ₃	YES /	NO
		YES /	NO
Metals	Cool 4°C & HNO ₃	YES /	NO
Metals	Cool 4°C & HNO ₃	YES /	NO
Metals	Cool 4°C & HNO ₃	YES /	NO
Metals	Cool 4°C & HNO ₃	YES /	NO
Metals	Cool 4°C & HNO ₃ Cool 4°C & NaOH	YES /	NO
Metals Cyanide	Cool 4°C & HNO ₃ Cool 4°C & NaOH	YES /	NO



TEST PIT LOG

Page ___ of ___

	ECT NAM				T PIT I	No.:		
PROJ LOCA	ECT NUM	IBER: _		DATE GEO	≣: LOGIS	ST:		
		_	MATERIAL DESCRIPTION				PID/FID I	READING
Depth (Ft.)	Lithology Change (Depth/Ft.)		Soil/Waste Characteristic (lithology, density, color, e		USCS	Remarks	Source (ppm)	BZ (ppm)
	1							
	1							
	-							
	1							
	<u> </u>							
TEST	PIT CRO	SS SEC	TION AND / OR PLAN VIEW					
	D 165							
REMA	ARKS:							
PHOT	O LOG:							

TŁ.

TETRA TECH MRP FF.1

SAP Worksheet #4 (Field Personnel) Project Personnel Sign-off Sheet

Facility/Location:	
Site(s):	

Date	Organization/Role	Name	Signature
	Tetra Tech/FOL		
	Tetra Tech/UXO Technician		

I have read and understood the SAP relative to assigned roles, per SAP Worksheet No. 3.



MRP FF.3 DAILY EQUIPMENT CHECKLIST

Facility/Location:	
Site(s):	

Equipment:					Initial Condition Out of the Box Acceptable (Y/N/NA)						
Serial N	umher:				Inei	oection	Spare parts				
Descrip					1113	Jection	Opare parts	Gable Oil	une rest		
Date	Time		Monument	Chackad	Date	Time		Chacka	d Monument		
Out	Out	Daily Cond. & Comments Out	Check (1)			In	Daily Cond. & Comments	In In By	Check (1)		

(1) For GPS Units, confirm accuracy correlation to referenced monument locations. Please record general description of monument locations in the Daily Activity Log, once established. (Example – GPS QC Location – Well MW-3 or northwest corner of intersection of Perimeter Road and Munitions Street)

Last Revised: 3/31/2011



Facility/Location:	
Site(s):	

Photograph Number	Date	Taken By (initials)	Subject/Description	Anomaly ID (if applicable)	Remarks/Comments



Facility/Location:	
Site(s):	

Photograph Number	Date	Taken By (initials)	Subject/Description	Anomaly ID (if applicable)	Remarks/Comments



Facility/Location:	
Site(s):	

Photograph Number	Date	Taken By (initials)	Subject/Description	Anomaly ID (if applicable)	Remarks/Comments



Facility/Location:	
Site(s):	

Photograph Number	Date	Taken By (initials)	Subject/Description	Anomaly ID (if applicable)	Remarks/Comments



TETRA TECH MRP FF.23 FIELD CHANGE REQUEST (FCR)

Facility/Lo	cation:	
Site(s):		
CONTRACT TASK ORDER NAME:	CTO #	CHANGE REQUEST NO.
TO:	LOCATION:	DATE:
RE:		
SAP Worksheet:	Section	:
ESS Section:		
SOP Section:		
Other:		
1. DESCRIPTION (cite or attach spe	ecific text/figure changes,	as necessary):
2. REASON FOR CHANGE 3. RECOMMENDED DISPOSITION Minor Change		
Minor Change 4. APPROVAL:	Major Change (Impacts Cost, Schedule)
4. APPROVAL: Not Approved (give reason).		
	APPROVED per recommer	nded disposition – Documents will not be formally revised.
_	_	contract modification process
Prepared by (Signature)	nem approvar required via	Date:
r repared by (Signature)		Date.
Tetra Tech UXO Manager (Signature	e)	Date:
Tetra Tech Project Manager (Signatu	ire)	Date:

Client Point of Contact / Client Representative (Signature) (Not

applicable if minor change)

Date:

APPENDIX H LABORATORY DOD ELAP CERTIFICATION/MAINE CERTIFICATION





Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2223

Katahdin Analytical Services, Inc.

600 Technology Way Scarborough ME 04074

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: February 1, 2016

202

R. Douglas Leonard, Jr., President, COO Laboratory Accreditation Bureau Presented the 1st of February 2013



Scope of Accreditation For Katahdin Analytical Services, Inc.

600 Technology Way Scarborough, ME 04074 Leslie Dimond 207-874-2400

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Katahdin Analytical Services to perform the following tests:

Accreditation granted through: February 1, 2016

Testing - Environmental

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8081B	2, 4`-DDD
GC/ECD	EPA 8081B	2, 4`-DDE
GC/ECD	EPA 8081B	2, 4`-DDT
GC/ECD	EPA 608; EPA 8081B	4, 4`-DDD
GC/ECD	EPA 608; EPA 8081B	4, 4`-DDE
GC/ECD	EPA 608; EPA 8081B	4, 4`-DDT
GC/ECD	EPA 608; EPA 8081B	Aldrin
GC/ECD	EPA 608; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Alpha-Chlordane
GC/ECD	EPA 608; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Cis-Nonaclor
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608; EPA 8081B	delta-BHC
GC/ECD	EPA 608; EPA 8081B	Dieldrin
GC/ECD	EPA 608; EPA 8081B	Endosulfan I
GC/ECD	EPA 608; EPA 8081B	Endosulfan II

Form 403.8 – Rev 1 – 4-11-11 Page 1 of 41



n-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 608; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608; EPA 8081B	Endrin
GC/ECD	EPA 608; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin Ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma- Hex <mark>achloro</mark> cyclohexane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608; EPA 8081B	Heptachlor
GC/ECD	EPA 608; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Hexachlorobenzene
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Mirex
GC/ECD	EPA 8081B	Oxychlordane
GC/ECD	EPA 608; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8081B	trans-Nonachlor
GC/ECD	EPA 608; EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608; EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A MOD	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A MOD	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)
GC/ECD	EPA 8082A	2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)
GC/ECD	EPA 8082A	2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 180)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5', 6-Heptachlorobiphenyl (BZ 183)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5-Hexachlorobiphenyl (BZ 138)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 6, 6'-Heptachlorobiphenyl (BZ 184)

Form 403.8 – Rev 1 – 4-11-11 Page 2 of 41



n-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8082A	2, 2', 3, 4', 5, 5', 6-Heptachlorobiphenyl (BZ 187)
GC/ECD	EPA 8082A	2, 2', 3, 4, 5'-Pentachlorobiphenyl (BZ 87)
GC/ECD	EPA 8082A	2, 2', 3, 5'-Tetrachlorobiphenyl (BZ 44)
GC/ECD	EPA 8082A	2, 2', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 153)
GC/ECD	EPA 8082A	2, 2', 4, 5, 5'-Pentachlorobiphenyl (BZ 101)
GC/ECD	EPA 8082A	2, 2', 4, 5-Tetrachlorobiphenyl (BZ 48)
GC/ECD	EPA 8082A	2, 2', 4, 5'-Tetrachlorobiphenyl (BZ 49)
GC/ECD	EPA 8082A	2, 2', 5, 5'-Tetrachlorobiphenyl (BZ 52)
GC/ECD	EPA 8082A	2, 2', 5-Trichlorobiphenyl (BZ 18)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5-Hexachlorobiphenyl (BZ 156)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5'-Hexachlorobiphenyl (BZ 157)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4'-Pentachlorobiphenyl (BZ 105)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 189
GC/ECD	EPA 8082A	2, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 167)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 118)
GC/ECD	EPA 8082A	2, 3', 4, 4',5'-Pentachlorobiphenyl (BZ 123)
GC/ECD	EPA 8082A	2, 3', 4, 4'-Tetrachlorobiphenyl (BZ 66)
GC/ECD	EPA 8082A	2, 3, 4, 4', 5-Pentachlorobiphenyl (BZ 114)
GC/ECD	EPA 8082A	2, 4, 4'-Trichlorobiphenyl (BZ 28)
GC/ECD	EPA 8082A	2, 4'-Dichlorobiphenyl (BZ 8)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 169)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 126)
GC/ECD	EPA 8082A	3, 3', 4, 4'-Tetrachlorobiphenyl (BZ 77)
GC/ECD	EPA 8082A	3, 4, 4', 5-Tetrachlorobiphenyl (BZ 81)
GC/ECD	EPA 8082A	Decachlorobiphenyl (BZ 209)
GC/ECD	EPA 8151A	2, 4, 5-T
GC/ECD	EPA 8151A	2, 4-D
GC/ECD	EPA 8151A	2, 4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop

Form 403.8 – Rev 1 – 4-11-11 Page 3 of 41



Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	МСРР
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2, 4, 5-TP)
GC/FID	EPA 8015C/D MOI	Diesel range organics (DRO)
GC/FID	EPA 8015C/D MOI	Total Petroleum Hydrocarbon (TPH)
GC/FID	EPA 8015C/D MOI	Gasoline range organics (GRO)
GC/FID/PID	MA DEP VPH	Volatile Organic Hydrocarbons
GC/FID	MA DEP EPH	Extractable Petroleum Hydrocarbons
GC/FID	CT ETPH	Total Petroleum Hydrocarbons
GC/FID	TNRCC Method 100	Total Petroleum Hydrocarbons
GC/FID	FL-PRO	Petroleum Range Organics
GC/ECD	EPA 8011; EPA 504	1, 2-Dibromoethane (EDB)
GC/ECD	EPA 8011; EPA 504	1, 2-Dibromo-3-chloropropane
GC/FID	RSK-175	Methane Ethane Ethene
GC/MS	EPA 8260B/C; EPA 52	24.2 1, 1, 1, 2-Tetrachloroethane
GC/MS	EPA 624; EPA 8260B/C 524.2	EPA 1, 1, 1-Trichloroethane
GC/MS	EPA 624; 8260B/C EPA 524.2	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 624; EPA 8260B/C 524.2	1, 1, 2-1 richioroethane
GC/MS	EPA 624; EPA 8260B/C 524.2	1, 1-Dichloroethane
GC/MS	EPA 624; EPA 8260B/C 524.2	EPA 1, 1-Dichloroethene
GC/MS	EPA 8260B/C; EPA 52	1, 1-Dichloropropene
GC/MS	EPA 8260B/C; EPA 52	1, 2, 3-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 52	1, 2, 3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/C; EPA 52	24.2 1, 2, 4-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 52	24.2 1, 2, 4-Trimethylbenzene

Form 403.8 – Rev 1 – 4-11-11 Page 4 of 41



n-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 524.2	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C; EPA 524.2	1, 2-Dibromoethane (EDB)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichlorobenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 3, 5-Trimethylbenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 3-Dichlorobenzene
GC/MS	EPA 8260B/C; EPA 524.2	1, 3-Dichloropropane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	1, 4-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C; EPA 524.2	2, 2-Dichloropropane
GC/MS	EPA 8260B/C; EPA 524.2	2-Butanone
GC/MS	EPA 624; EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C; EPA 524.2	2-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 524.2	2-Hexanone
GC/MS	EPA 8260B/C; EPA 524.2	4-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 524.2	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C; EPA 524.2	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 624; EPA 8260B/C	Acrolein
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Acrylonitrile
GC/MS	EPA 8260B/C; EPA 524.2	Allyl chloride
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Benzene
GC/MS	EPA 8260B/C	Benzyl chloride
GC/MS	EPA 8260B/C; EPA 524.2	Bromobenzene
GC/MS	EPA 8260B/C; EPA 524.2	Bromochloromethane

Form 403.8 – Rev 1 – 4-11-11 Page 5 of 41



on-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Bromodichloromethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Bromoform
GC/MS	EPA 8260B/C; EPA 524.2	Carbon disulfide
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Carbon tetrachloride
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chlorobenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chloroethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C; EPA 524.2	cis-1, 2-Dichloroethene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	cis-1, 3-Dichloropropene
GC/MS	EPA 8260B/C	Cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Dibromochloromethane
GC/MS	EPA 8260B/C; EPA 524.2	Dibromomethane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Dichlorodifluoromethane
GC/MS	EPA 8260B/C; EPA 524.2	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropylether
GC/MS	EPA 8260B/C; EPA 524.2	Ethyl methacrylate
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Ethylbenzene
GC/MS	EPA 8260B/C	Ethyl-t-butylether
GC/MS	EPA 8260B/C; EPA 524.2	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropyl alcohol
GC/MS	EPA 8260B/C; EPA 524.2	Isopropyl benzene
GC/MS	EPA 8260B/C; EPA 524.2	m p-xylenes
GC/MS	EPA 8260B/C	Methyl acetate

Form 403.8 – Rev 1 – 4-11-11 Page 6 of 41



on-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 524.2	Methacrylonitrile
GC/MS	EPA 624 / 8260B,C	Methyl bromide (Bromomethane)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C; EPA 524.2	Methyl methacrylate
GC/MS	EPA 8260B/C; EPA 524.2	Methyl tert-butyl ether
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Methylene chloride
GC/MS	EPA 8260B/C; EPA 524.2	Naphthalene
GC/MS	EPA 8260B/C; EPA 524.2	n-Butylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	n-Propylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	o-Xylene
GC/MS	EPA 8260B/C	Pentachloroethane
GC/MS	EPA 8260B/C; EPA 524.2	p-Isopropyltoluene
GC/MS	EPA 8260B/C; EPA 524.2	Propionitrile
GC/MS	EPA 8260B/C; EPA 524.2	sec-butylbenzene
GC/MS	EPA 8260B/C; EPA 524.2	Styrene
GC/MS	EPA 8260B/C	t-Amylmethylether
GC/MS	EPA 8260B/C; EPA 524.2	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Tetrachloroethene (Perchloroethylene)
GC/MS	EPA 8260B/C; EPA 524.2	Tetrahydrofuran
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Toluene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	trans-1, 2-Dichloroethylene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	trans-1, 3-Dichloropropylene
GC/MS	EPA 8260B/C; EPA 524.2	trans-1, 4-Dichloro-2-butuene
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate

Form 403.8 – Rev 1 – 4-11-11 Page 7 of 41



on-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 624; EPA 8260B/C; EPA 524.2	Vinyl chloride
GC/MS	EPA 624 / 8260B,C	Xylene
GC/MS	EPA 8260B/C SIM	1,1,1,2-Tetrachloroethane
GC/MS	8260B, C SIM	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethene
GC/MS	EPA 8260B/C SIM	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C SIM	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C SIM	1,2-Dibromoethane
GC/MS	EPA 8260B/C SIM	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,2-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,3-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	2-Hexanone
GC/MS	EPA 8260B/C SIM	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C SIM	Benzene
GC/MS	EPA 8260B/C SIM	Bromodichloromethane
GC/MS	EPA 8260B/C SIM	Carbon Tetrachloride
GC/MS	EPA 8260B/C SIM	Chloroform
GC/MS	EPA 8260B/C SIM	Chloromethane
GC/MS	EPA 8260B/C SIM	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Dibromochloromethane
GC/MS	EPA 8260B/C SIM	Ethylbenzene
GC/MS	EPA 8260B/C SIM	Isopropylbenzene

Form 403.8 – Rev 1 – 4-11-11 Page 8 of 41



D1 1	3.6.41.3	1 7 /
Technology	Method	Analyte
GC/MS	EPA 8260B/C SIM	Hexachlorobutadiene
GC/MS	EPA 8260B/C SIM	Methylcyclohexane
GC/MS	EPA 8260B/C SIM	m,p-Xylene
GC/MS	EPA 8260B/C SIM	o-Xylene
GC/MS	EPA 8260B/C SIM	Tetrachloroethene
GC/MS	EPA 8260B/C SIM	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	Trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Trichloroethene
GC/MS	EPA 8260B/C SIM	Trichlorofluoromethane
GC/MS	EPA 8260B/C SIM	Vinyl Chloride
GC/MS	EPA 8260B/C SIM	Xylenes (total)
GC/MS	EPA 8270C/D	1, 2, 4, 5-Tetrachlorobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 2, 4-Trichlorobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 2-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1, 3, 5-Trinitrobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 3-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 3-Dinitrobenzene
GC/MS	EPA 625; EPA 8270C/D	1, 4-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 4-Dioxane
GC/MS	EPA 8270C/D	1, 4-Naphthoquinone
GC/MS	EPA 8270C/D	1, 4-Phenylenediamine
GC/MS	EPA 8270C/D	1-Chloronaphthalene
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	1-Naphthylamine
GC/MS	EPA 8270C/D	2, 3, 4, 6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2, 4, 5-Trochlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4, 6-Trichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dimethylphenol
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dinitrophenol

Form 403.8 – Rev 1 – 4-11-11 Page 9 of 41



n-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 625; EPA 8270C/D	2, 4-Dinitrotoluene (2, 4-DNT)
GC/MS	EPA 8270C/D	2, 6-Dichlorophenol
GC/MS	EPA 625; EPA 8270C/D	2, 6-Dinitrotoluene (2, 6-DNT)
GC/MS	EPA 8270C/D	2-Acetylaminofluorene
GC/MS	EPA 625; EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 625; EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 625; EPA 8270C/D	2-Methyl-4 6-dinitrophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol
GC/MS	EPA 8270C/D	2-Naphthylamine
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 625; EPA 8270C/D	2-Nitrophenol
GC/MS	EPA 8270C/D	2-Picoline
GC/MS	EPA 8270C/D	3-Methylcholanthrene
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4-Aminobiphenyl
GC/MS	EPA 625; EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 625; EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 625; EPA 8270C/D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C/D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270C/D	3, 4-Methylphenol
GC/MS	EPA 8270C/D	4-Nitroaniline
GC/MS	EPA 625; EPA 8270C/D	4-Nitrophenol
GC/MS	EPA 8270C/D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	5-Nitro-o-toluidine
GC/MS	EPA 8270C/D	7, 12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	a a-Dimethylphenethylamine
GC/MS	EPA 625; EPA 8270C/D	Acenaphthene
GC/MS	EPA 625; EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetophenone

Form 403.8 – Rev 1 – 4-11-11 Page 10 of 41



n-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 625; EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Aramite
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Azobenzene
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 625; EPA 8270C/D	Benzidine
GC/MS	EPA 625; EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 625; EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 625; EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 625; EPA 8270C/D	Benzo(g h i)perylene
GC/MS	EPA 625; EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	1,1-Biphenyl
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroethyl) ether
GC/MS	EPA 625; EPA 8270C/D	bis(2-Chloroisopropyl) ether (2, 2`-Oxybis(1-chloropropane)
GC/MS	EPA 625; EPA 8270C/D	bis(2-Ethylhexyl)adipate
GC/MS	EPA 625; EPA 8270C/D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270C/D	Butyl benzyl phthalate
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chlorobenzilate
GC/MS	EPA 625; EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Diallate
GC/MS	EPA 8270C/D	Dibenzo(a,j)acridine
GC/MS	EPA 625; EPA 8270C/D	Dibenz(a h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran
GC/MS	EPA 8270C/D	Diethyladipate
GC/MS	EPA 625; EPA 8270C/D	Diethyl phthalate

Form 403.8 – Rev 1 – 4-11-11 Page 11 of 41



-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Dimethoate
GC/MS	EPA 625; EPA 8270C/D	Dimethyl phthalate
GC/MS	EPA 625; EPA 8270C/D	Di-n-butyl phthalate
GC/MS	EPA 625; EPA 8270C/D	Di-n-octyl phthalate
GC/MS	EPA 8270C/D	Dinoseb
GC/MS	EPA 8270C/D	Disulfoton
GC/MS	EPA 8270C/D	Ethyl methanesulfonate
GC/MS	EPA 8270C/D	Ethyl parathion
GC/MS	EPA 8270C/D	Ethyl methacrylate
GC/MS	EPA 8270C/D	Famfur
GC/MS	EPA 625; EPA 8270C/D	Fluoranthene
GC/MS	EPA 625; EPA 8270C/D	Fluorene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorobenzene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorobutadiene
GC/MS	EPA 625; EPA 8270C/D	Hexachlorocyclopentadiene
GC/MS	EPA 625; EPA 8270C/D	Hexachloroethane
GC/MS	EPA 8270C/D	Hexachlorophene
GC/MS	EPA 8270C/D	Hexachloropropene
GC/MS	EPA 625; EPA 8270C/D	Indeno(1, 2, 3-cd)pyrene
GC/MS	EPA 8270C/D	Isodrin
GC/MS	EPA 625; EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Isosafrole
GC/MS	EPA 8270C/D	Kepone
GC/MS	EPA 8270C/D	Methapyriline
GC/MS	EPA 8270C/D	Methy methanesulfonate
GC/MS	EPA 8270C/D	Methyl parathion
GC/MS	EPA 625; EPA 8270C/D	Naphthalene
GC/MS	EPA 625; EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	n-Nitrosodiethylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodimethylamine

Form 403.8 – Rev 1 – 4-11-11 Page 12 of 41



on-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	n-Nitroso-di-n-butylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodi-n-propylamine
GC/MS	EPA 625; EPA 8270C/D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D	n-Nitrosomethylethylamine
GC/MS	EPA 8270C/D	n-Nitrosomorpholine
GC/MS	EPA 8270C/D	n-Nitrosopiperidine
GC/MS	EPA 8270C/D	n-Nitrosopyrrolidine
GC/MS	EPA 8270C/D	O,O,O-Triethyl phosphorothioate
GC/MS	EPA 8270C/D	o,o-Diethyl o-2pyrazinyl phosphorothioate
GC/MS	EPA 8270C/D	o-Toluidine
GC/MS	EPA 8270C/D	Pentachlorobenzene
GC/MS	EPA 8270C/D	Pentachloronitrobenzene
GC/MS	EPA 625; EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenacetin
GC/MS	EPA 625; EPA 8270C/D	Phenanthrene
GC/MS	EPA 625; EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Phorate
GC/MS	EPA 8270C/D	Pronamide
GC/MS	EPA 625; EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/MS	EPA 8270C/D	Safrole
GC/MS	EPA 8270C/D	Sulfotepp
GC/MS	EPA 8270C/D	Thionazin
GC/MS	EPA 625; EPA 8270C/D	3, 3'-Dichlorobenzidine
GC/MS	EPA 8270C/D	3, 3'-Dimethylbenzidine
GC/MS	EPA 8270C/D SIM	1,1'-Biphenyl
GC/MS	EPA 8270C/D SIM	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D SIM	1,4-Dioxane
GC/MS	EPA 8270C/D SIM	1-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2,2'-Oxybis(1-chloropropane
GC/MS	EPA 8270C/D SIM	2,3,4,6-Tetrachlorophenol

Form 403.8 – Rev 1 – 4-11-11 Page 13 of 41



n-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4,6-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dichlorophenol
GC/MS	EPA 8270C/D SIM	2,4-Dimethylphenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrophenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2-Chloronaphthalene
GC/MS	EPA 8270C/D SIM	2-Chlorophenol
GC/MS	EPA 8270C/D SIM	2-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2-Methylphenol
GC/MS	EPA 8270C/D SIM	2-Nitroaniline
GC/MS	EPA 8270C/D SIM	2-Nitrophenol
GC/MS	EPA 8270C/D SIM	3&4-Methylphenol
GC/MS	EPA 8270C/D SIM	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/D SIM	3-Nitroaniline
GC/MS	EPA 8270C/D SIM	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/D SIM	4-Bromophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D SIM	4-Chloroaniline
GC/MS	EPA 8270C/D SIM	4-Chlorophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Nitroaniline
GC/MS	EPA 8270C/D SIM	4-Nitrophenol
GC/MS	EPA 8270C/D SIM	Acenaphthene
GC/MS	EPA 8270C/D SIM	Acenaphthylene
GC/MS	EPA 8270C/D SIM	Acetophenone
GC/MS	EPA 8270C/D SIM	Anthracene
GC/MS	EPA 8270C/D SIM	Atrazine
GC/MS	EPA 8270C/D SIM	Benzaldehyde
GC/MS	EPA 8270C/D SIM	Benzo(a)anthracene
GC/MS	EPA 8270C/D SIM	Benzo(a)pyrene

Form 403.8 – Rev 1 – 4-11-11 Page 14 of 41



Foologo 1	N/L-41- 1	A 1 4
Fechnology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/D SIM	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270C/D SIM	Butylbenzylphthalate
GC/MS	EPA 8270C/D SIM	Caprolactam
GC/MS	EPA 8270C/D SIM	Carbazole
GC/MS	EPA 8270C/D SIM	Chrysene
GC/MS	EPA 8270C/D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270C/D SIM	Dibenzofuran
GC/MS	EPA 8270C/D SIM	Diethylphthalate
GC/MS	EPA 8270C/D SIM	Dimethyl phthalate
GC/MS	EPA 8270C/D SIM	Di-n-butylphthalate
GC/MS	EPA 8270C/D SIM	Di-n-octylphthalate
GC/MS	EPA 8270C/D SIM	Fluoranthene
GC/MS	EPA 8270C/D SIM	Fluorene
GC/MS	EPA 8270C/D SIM	Hexachlorobenzene
GC/MS	EPA 8270C/D SIM	Hexachlorobutadiene
GC/MS	EPA 8270C/D SIM	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D SIM	Hexachloroethane
GC/MS	EPA 8270C/D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D SIM	Isophorone
GC/MS	EPA 8270C/D SIM	Naphthalene
GC/MS	EPA 8270C/D SIM	Nitrobenzene
GC/MS	EPA 8270C/D SIM	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270C/D SIM	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D SIM	Pentachlorophenol
GC/MS	EPA 8270C/D SIM	Phenanthrene
GC/MS	EPA 8270C/D SIM	Phenol

Form 403.8 – Rev 1 – 4-11-11 Page 15 of 41



Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Pyrene
HPLC/UV	EPA 8330A/B	1, 3, 5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1, 3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2, 4, 6-Trinitrotoluene
HPLC/UV	EPA 8330A/B	2, 4-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Amino-4, 6 -Dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	4-Amino-2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene
HPLC/UV	EPA 8330A/B	Ethylene glycol dinitrate (EGDN)
HPLC/UV	EPA 8330A/B	Hexahydro-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A MOD	Nitroglycerin
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	EPA 8330A/B	Tetryl
CVAA	EPA 245.1; EPA 7470A	Mercury
CVAF	EPA 1631E	Low Level Mercury
ICP/AES	EPA 200.7; EPA 6010B/C	Aluminum
ICP/AES	EPA 200.7; EPA 6010B/C	Antimony
ICP/AES	EPA 200.7; EPA 6010B/C	Arsenic
ICP/AES	EPA 200.7; EPA 6010B/C	Barium
ICP/AES	EPA 200.7; EPA 6010B/C	Beryllium
ICP/AES	EPA 200.7; EPA 6010B/C	Boron
ICP/AES	EPA 200.7; EPA 6010B/C	Cadmium
ICP/AES	EPA 200.7; EPA 6010B/C	Calcium
ICP/AES	EPA 200.7; EPA 6010B/C	Chromium

Form 403.8 – Rev 1 – 4-11-11 Page 16 of 41



1-Potable Water		
Technology	Method	Analyte
ICP/AES	EPA 200.7; EPA 6010B/C	Cobalt
ICP/AES	EPA 200.7; EPA 6010B/C	Copper
ICP/AES	EPA 200.7; EPA 6010B/C	Iron
ICP/AES	EPA 200.7; EPA 6010B/C	Lead
ICP/AES	EPA 200.7; EPA 6010B/C	Magnesium
ICP/AES	EPA 200.7; EPA 6010B/C	Manganese
ICP/AES	EPA 200.7; EPA 6010B/C	Molybdenum
ICP/AES	EPA 200.7; EPA 6010B/C	Nickel
ICP/AES	EPA 200.7; EPA 6010B/C	Potassium
ICP/AES	EPA 200.7; EPA 6010B/C	Selenium
ICP/AES	EPA 200.7; EPA 6010B/C	Silicon
ICP/AES	EPA 200.7; EPA 6010B/C	Silver
ICP/AES	EPA 200.7; EPA 6010B/C	Sodium
ICP/AES	EPA 6010B/C	Strontium
ICP/AES	EPA 200.7; EPA 6010B/C	Thallium
ICP/AES	EPA 200.7; EPA 6010B/C	Tin
ICP/AES	EPA 200.7; EPA 6010B/C	Titanium
ICP/AES	EPA 200.7; EPA 6010B/C	Vanadium
ICP/AES	EPA 200.7; EPA 6010B/C	Zinc
ICP/MS	EPA 200.8; EPA 6020A	Aluminum
ICP/MS	EPA 200.8; EPA 6020A	Antimony
ICP/MS	EPA 200.8; EPA 6020A	Arsenic
ICP/MS	EPA 200.8; EPA 6020A	Barium
ICP/MS	EPA 200.8; EPA 6020A	Beryllium
ICP/MS	EPA 200.8; EPA 6020A	Boron
ICP/MS	EPA 200.8; EPA 6020A	Cadmium
ICP/MS	EPA 200.8; EPA 6020A	Calcium
ICP/MS	EPA 200.8; EPA 6020A	Chromium
ICP/MS	EPA 200.8; EPA 6020A	Cobalt
ICP/MS	EPA 200.8; EPA 6020A	Copper
ICP/MS	EPA 200.8; EPA 6020A	Iron

Form 403.8 – Rev 1 – 4-11-11 Page 17 of 41



Non-Potable Water		
Technology	Method	Analyte
ICP/MS	EPA 200.8; EPA 6020A	Lead
ICP/MS	EPA 200.8; EPA 6020A	Magnesium
ICP/MS	EPA 200.8; EPA 6020A	Manganese
ICP/MS	EPA 200.8; EPA 6020A	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A	Nickel
ICP/MS	EPA 200.8; EPA 6020A	Potassium
ICP/MS	EPA 200.8; EPA 6020A	Selenium
ICP/MS	EPA 200.8; EPA 6020A	Silicon
ICP/MS	EPA 200.8; EPA 6020A	Silver
ICP/MS	EPA 200.8; EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 200.8; EPA 6020A	Thallium
ICP/MS	EPA 200.8; EPA 6020A	Tin
ICP/MS	EPA 200.8; EPA 6020A	Titanium
ICP/MS	EPA 200.8; EPA 6020A	Tungsten
ICP/MS	EPA 200.8	Uranium
ICP/MS	EPA 200.8; EPA 6020A	Vanadium
ICP/MS	EPA 200.8; EPA 6020A	Zinc
IC	EPA 300.0; EPA 9056A	Bromide
IC	EPA 300.0; EPA 9056A	Chloride
IC	EPA 300.0; EPA 9056A	Fluoride
IC	EPA 300.0; EPA 9056A	Nitrate as N
IC	EPA 300.0; EPA 9056A	Nitrite as N
IC	EPA 300.0; EPA 9056A	Nitrate + Nitrite
IC	EPA 300.0; EPA 9056A	Orthophosphate as P
IC	EPA 300.0; EPA 9056A	Sulfate
IC	SOP CA-776	Lactic Acid
IC	SOP CA-776	Acetic Acid
IC	SOP CA-776	Propionic Acid
IC	SOP CA-776	Formic Acid
IC	SOP CA-776	Butyric Acid

Form 403.8 – Rev 1 – 4-11-11 Page 18 of 41



on-Potable Water		
Technology	Method	Analyte
IC	SOP CA-776	Pyruvic Acid
IC	SOP CA-776	i-Pentanoic Acid
IC	SOP CA-776	Pentanoic Acid
IC	SOP CA-776	i-Hexanoic Acid
IC	SOP CA-776	Hexanoic Acid
Titration	EPA 310.1; SM 2320B	Alkalinity
Caculation	SM 2340B	Hardness
Gravimetric	EPA 1664A; EPA 9070A	Oil and Grease, Oil and Grease with SGT
Gravimetric	SM 2540B/C/D	Solids
ISE	EPA 120.1; SM 2510B	Conductivity
ISE	SM 2520B	Practical Salinity
ISE	SM 4500F- C	Fluoride
ISE	SM 4500H+ B	рН
ISE	SM 5210B	TBOD / CBOD
Physical	EPA 1010A	Ignitability
Physical	EPA 9040C	pH
Titration	SM 2340C	Hardness
Titration	SM 4500SO ₃ B	Sulfite
Titration	EPA 9034; SM 4500S ²⁻ F	Sulfide
Titration	EPA SW-846 Chapter 7.3.4	Reactive Sulfide
IR	EPA 9060A; SM 5310B	Total organic carbon
Turbidimetric	EPA 180.1; SM 2130B	Turbidity
Turbidimetric	EPA 9038; ASTM 516-02	Sulfate
UV/VIS	EPA 335.4; EPA 9012B; SM 4500-CN G	Amenable cyanide
UV/VIS	EPA 350.1; SM 4500NH3 H	Ammonia as N
UV/VIS	SM 3500Fe D	Ferrous Iron
UV/VIS	EPA 351.2	Kjeldahl nitrogen - total
UV/VIS	EPA 353.2; SM 4500NO3 F	Nitrate + Nitrite
UV/VIS	EPA 353.2; SM 4500NO3 F	Nitrate as N
UV/VIS	EPA 353.2; SM 4500NO3 F	Nitrite as N
UV/VIS	EPA 365.2; SM 4500P E	Orthophosphate as P

Form 403.8 – Rev 1 – 4-11-11 Page 19 of 41



Non-Potable Water	Non-Potable Water		
Technology	Method	Analyte	
UV/VIS	EPA 365.4	Phosphorus total	
UV/VIS	EPA 821/R-91-100	AVS-SEM	
UV/VIS	EPA 410.4	COD	
UV/VIS	EPA 420.1; EPA 9065	Total Phenolics	
UV/VIS	SM 4500Cl G	Total Residual Chlorine	
UV/VIS	SM 5540C	MBAS	
UV/VIS	EPA 7196A; SM 3500-Cr D	Chromium VI	
UV/VIS	EPA 9012B; EPA 335.4	Total Cyanide	
UV/VIS	EPA 9251; SM 4500Cl E	Chloride	
UV/VIS	EPA SW-846 Chapter 7.3.4	Reactive Cyanide	

Preparation	Method	Туре
Cleanup Methods	EPA 3640A	Gel Permeation Clean-up
Cleanup Methods	EPA 3630C	Silica Gel
Cleanup Methods	EPA 3660B	Sulfur Clean-Up
Cleanup Methods	EPA 3665A	Sulfuric Acid Clean-Up
Organic Preparation	EPA 3510C	Separatory Funnel Extraction
Organic Preparation	EPA 3520C	Continuous Liquid-Liquid Extraction
Inorganic Preparation	EPA 3010A	Hotblock
Volatile Organic Preparation	EPA 5030C	Purge and Trap

Solid and Chemical Wa	Solid and Chemical Waste		
Technology	Method	Analyte	
GC/ECD	EPA 8081B	2,4`-DDD	
GC/ECD	EPA 8081B	2,4`-DDE	
GC/ECD	EPA 8081B	2,4`-DDT	
GC/ECD	EPA 8081B	4, 4`-DDD	
GC/ECD	EPA 8081B	4, 4`-DDE	
GC/ECD	EPA 8081B	4, 4`-DDT	
GC/ECD	EPA 8081B	Aldrin	

Form 403.8 – Rev 1 – 4-11-11 Page 20 of 41



Гесhnology	Method	Analyte
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Alpha-Chlordane
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	Cis-Nonachlor
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin Ketone
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma- Hexachlorocyclohexane)
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Hexachlorobenzene
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Mirex
GC/ECD	EPA 8081B	Oxychlordane
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8081B	Trans-Nonachlor
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)

Form 403.8 – Rev 1 – 4-11-11 Page 21 of 41



d and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8082A MOD	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5, 5', 6-Nonachlorobiphenyl (BZ 206)
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5, 6-Octachlorobiphenyl (BZ 19
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4', 5-Heptachlorobiphenyl (BZ 170
GC/ECD	EPA 8082A	2, 2', 3, 3', 4, 4'-Hexachlorobiphenyl (BZ 128)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 180
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5', 6-Heptachlorobiphenyl (BZ 183
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 5-Hexachlorobiphenyl (BZ 138)
GC/ECD	EPA 8082A	2, 2', 3, 4, 4', 6, 6'-Heptachlorobiphenyl (BZ 184
GC/ECD	EPA 8082A	2, 2', 3, 4', 5, 5', 6-Heptachlorobiphenyl (BZ 187
GC/ECD	EPA 8082A	2, 2', 3, 4, 5'-Pentachlorobiphenyl (BZ 87)
GC/ECD	EPA 8082A	2, 2', 3, 5'-Tetrachlorobiphenyl (BZ 44)
GC/ECD	EPA 8082A	2, 2', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 153)
GC/ECD	EPA 8082A	2, 2', 4, 5, 5'-Pentachlorobiphenyl (BZ 101)
GC/ECD	EPA 8082A	2, 2', 4, 5-Tetrachlorobiphenyl (BZ 48)
GC/ECD	EPA 8082A	2, 2', 4, 5'-Tetrachlorobiphenyl (BZ 49)
GC/ECD	EPA 8082A	2, 2', 5, 5'-Tetrachlorobiphenyl (BZ 52)
GC/ECD	EPA 8082A	2, 2', 5-Trichlorobiphenyl (BZ 18)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5-Hexachlorobiphenyl (BZ 156)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5'-Hexachlorobiphenyl (BZ 157)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4'-Pentachlorobiphenyl (BZ 105)
GC/ECD	EPA 8082A	2, 3, 3', 4, 4', 5, 5'-Heptachlorobiphenyl (BZ 18
GC/ECD	EPA 8082A	2, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 167)
GC/ECD	EPA 8082A	2, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 118)
GC/ECD	EPA 8082A	2, 3', 4, 4',5'-Pentachlorobiphenyl (BZ 123)
GC/ECD	EPA 8082A	2, 3', 4, 4'-Tetrachlorobiphenyl (BZ 66)
GC/ECD	EPA 8082A	2, 3, 4, 4', 5-Pentachlorobiphenyl (BZ 114)
GC/ECD	EPA 8082A	2, 4, 4'-Trichlorobiphenyl (BZ 28)
GC/ECD	EPA 8082A	2, 4'-Dichlorobiphenyl (BZ 8)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5, 5'-Hexachlorobiphenyl (BZ 169)
GC/ECD	EPA 8082A	3, 3', 4, 4', 5-Pentachlorobiphenyl (BZ 126)

Form 403.8 – Rev 1 – 4-11-11 Page 22 of 41



lid and Chemical Waste		
Technology	Method	Analyte
GC/ECD	EPA 8082A	3, 3', 4, 4'-Tetrachlorobiphenyl (BZ 77)
GC/ECD	EPA 8082A	3, 4, 4', 5-Tetrachlorobiphenyl (BZ 81)
GC/ECD	EPA 8082A	Decachlorobiphenyl (BZ 209)
GC/ECD	EPA 8151A	2, 4, 5-T
GC/ECD	EPA 8151A	2, 4-D
GC/ECD	EPA 8151A	2, 4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	МСРР
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2, 4, 5-TP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Total Petroleum Hydrocarbons (TPH)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID/PID	MA DEP VPH	Volatile Organic Hydrocarbons
GC/FID	MA DEP EPH	Extractable Petroleum Hydrocarbons
GC/FID	MA DEP EPH EPA 3546	Extractable Petroleum Hydrocarbons Microwave Extraction Preparation
GC/FID	СТ-ЕТРН	Total Petroleum Hydrocarbons
GC/FID	TNRCC Method 1005	Total Petroleum Hydrocarbons
GC/FID	FL-PRO	Petroleum Range Organics
GC/ECD	EPA 8011	1, 2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C	1, 1, 1, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane
GC/MS	EPA 8260B/C	1, 1, 1-Trichloroethane
GC/MS	EPA 8260B/C	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA 8260B/C	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C	1, 1-Dichloroethane

Form 403.8 – Rev 1 – 4-11-11 Page 23 of 41



Solid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	1, 1-Dichloroethylene
GC/MS	EPA 8260B/C	1, 1-Dichloropropene
GC/MS	EPA 8260B/C	1, 2, 3-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 2, 3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,3-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 2, 4-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C	1, 2-Dibromoethane
GC/MS	EPA 8260B/C	1, 2-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 2-Dichloroethane
GC/MS	EPA 8260B/C	1, 2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C	1, 3, 5-Trimethylbenzene
GC/MS	EPA 8260B/C	1, 3-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 3-Dichloropropane
GC/MS	EPA 8260B/C	1, 4-Dichlorobenzene
GC/MS	EPA 8260B/C	1, 4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2, 2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride

Form 403.8 – Rev 1 – 4-11-11 Page 24 of 41



Technology	Method	Analyte
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Benzyl chloride
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform
GC/MS	EPA 8260B/C	Carbon disulfide
GC/MS	EPA 8260B/C	Carbon tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	cis-1, 2-Dichloroethene
GC/MS	EPA 8260B/C	cis-1, 3-Dichloropropene
GC/MS	EPA 8260B/C	cis-1,3-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane
GC/MS	EPA 8260B/C	Dichlorodifluoromethane
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropylether
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Ethyl-t-butylether
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropyl alcohol
GC/MS	EPA 8260B/C	Isopropyl benzene
GC/MS	EPA 8260B/C	m p-xylenes

Form 403.8 – Rev 1 – 4-11-11 Page 25 of 41



Cechnology	Method	Analyte
GC/MS	EPA 8260B, C	Methyl acetate
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl tert-butyl ether
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methylene chloride
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	n-proplybenzene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	pentachloroethane
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Propionitrile
GC/MS	EPA 8260B/C	sec-butylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	t-Amylmethylether
GC/MS	EPA 8260B/C	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	trans-1, 2-Dichloroethylene
GC/MS	EPA 8260B/C	trans-1, 3-Dichloropropylene
GC/MS	EPA 8260B/C	Trans-1, 4-Dichloro-2-butuene
GC/MS	EPA 8260B/C	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C	Trichlorofluoromethane
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl chloride
GC/MS	EPA 8260B/C	Xylene

Form 403.8 – Rev 1 – 4-11-11 Page 26 of 41



echnology	Method	Analyte
GC/MS	EPA 8260B/C SIM	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C SIM	1, 1, 2-Trichloroethane
GC/MS	EPA 8260B/C SIM	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,1-Dichloroethene
GC/MS	EPA 8260B/C SIM	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C SIM	1,2-Dibromo-3-chloropropane
GC/MS	EPA 8260B/C SIM	1,2-Dibromoethane
GC/MS	EPA 8260B/C SIM	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,2-Dichloroethane
GC/MS	EPA 8260B/C SIM	1,2-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	1,3-Dichloropropane
GC/MS	EPA 8260B/C SIM	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C SIM	2-Hexanone
GC/MS	EPA 8260B/C SIM	4-Methyl-2-pentanone
GC/MS	EPA 8260B/C SIM	Benzene
GC/MS	EPA 8260B/C SIM	Bromodichloromethane
GC/MS	EPA 8260B/C SIM	Carbon Tetrachloride
GC/MS	EPA 8260B/C SIM	Chloroform
GC/MS	EPA 8260B/C SIM	Chloromethane
GC/MS	EPA 8260B/C SIM	cis-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Dibromochloromethane
GC/MS	EPA 8260B/C SIM	Ethylbenzene
GC/MS	EPA 8260B/C SIM	Isopropylbenzene
GC/MS	EPA 8260B/C SIM	Hexachlorobutadiene
GC/MS	EPA 8260B/C SIM	Methylcyclohexane

Form 403.8 – Rev 1 – 4-11-11 Page 27 of 41



Гесhnology	Method	Analyte
GC/MS	EPA 8260B/C SIM	m,p-Xylene
GC/MS	EPA 8260B/C SIM	o-Xylene
GC/MS	EPA 8260B/C SIM	Tetrachloroethene
GC/MS	EPA 8260B/C SIM	trans-1,2-Dichloroethene
GC/MS	EPA 8260B/C SIM	Trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C SIM	Trichloroethene
GC/MS	EPA 8260B/C SIM	Trichlorofluoromethane
GC/MS	EPA 8260B/C SIM	Vinyl Chloride
GC/MS	EPA 8260B/C SIM	Xylenes (total)
GC/MS	EPA 8270C/D	1, 2, 4, 5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1, 2, 4-Trichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1, 3, 5-Trinitrobenzene
GC/MS	EPA 8270C/D	1, 3-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 3-Dinitrobenzene
GC/MS	EPA 8270C/D	1, 4-Dichlorobenzene
GC/MS	EPA 8270C/D	1, 4-Dioxane
GC/MS	EPA 8270C/D	1, 4-Naphthoquinone
GC/MS	EPA 8270C/D	1, 4-Phenylenediamine
GC/MS	EPA 8270C/D	1,1-Biphenyl
GC/MS	EPA 8270C/D	1-Chloronaphthalene
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	1-Naphthylamine
GC/MS	EPA 8270C/D	2, 3, 4, 6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2, 4, 5-Trochlorophenol
GC/MS	EPA 8270C/D	2, 4, 6-Trichlorophenol
GC/MS	EPA 8270C/D	2, 4-Dichlorophenol
GC/MS	EPA 8270C/D	2, 4-Dimethylphenol
GC/MS	EPA 8270C/D	2, 4-Dinitrophenol

Form 403.8 – Rev 1 – 4-11-11 Page 28 of 41



Гесhnology	Method	Analyte
GC/MS	EPA 8270C/D	2, 6-Dichlorophenol
GC/MS	EPA 8270C/D	2, 6-Dinitrotoluene (2 6-DNT)
GC/MS	EPA 8270C/D	2-Acetylaminofluorene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methyl-4, 6-dinitrophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol
GC/MS	EPA 8270C/D	2-Naphthylamine
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol
GC/MS	EPA 8270C/D	2-Picoline
GC/MS	EPA 8270C/D	3, 3`-Dichlorobenzidine
GC/MS	EPA 8270C/D	3, 3'-Dimethylbenzidine
GC/MS	EPA 8270C/D	3,4-Methylphenol
GC/MS	EPA 8270C/D	3-Methylcholanthrene
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4-Aminobiphenyl
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenylether
GC/MS	EPA 8270C/D	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270C/D	4-Nitroaniline
GC/MS	EPA 8270C/D	4-Nitrophenol
GC/MS	EPA 8270C/D	4-Nitroquinoline-1-oxide
GC/MS	EPA 8270C/D	5-Nitro-o-toluidine
GC/MS	EPA 8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	EPA 8270C/D	a a-Dimethylphenethylamine
GC/MS	EPA 8270C/D	Acenaphthene

Form 403.8 – Rev 1 – 4-11-11 Page 29 of 41



Technology	Method	Analyte
GC/MS	EPA 8270C/D	Acetophenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Aramite
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Azobenzene
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g h i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benzyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl) ether
GC/MS	EPA 8270C/D	bis(2-Chloroisopropyl) ether (2, 2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625; EPA 8270C/D	Bis(2-Ethylhexyl)adipate
GC/MS	EPA 8270C/D	Butyl benzyl phthalate
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chlorobenzilate
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Diallate
GC/MS	EPA 8270C/D	Dibenz(a h)anthracene
GC/MS	EPA 8270C/D	Dibenzo(a,j)acridine
GC/MS	EPA 8270C/D	Dibenzofuran
GC/MS	EPA 8270C/D	Diethyl phthalate
GC/MS	EPA 8270C/D	Diethyladipate

Form 403.8 – Rev 1 – 4-11-11 Page 30 of 41



lid and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Dimethoate
GC/MS	EPA 8270C/D	Dimethyl phthalate
GC/MS	EPA 8270C/D	Di-n-butyl phthalate
GC/MS	EPA 8270C/D	Di-n-octyl phthalate
GC/MS	EPA 8270C/D	Dinoseb
GC/MS	EPA 8270C/D	Disulfoton
GC/MS	EPA 8270C/D	Ethyl methacrylate
GC/MS	EPA 8270C/D	Ethyl methanesulfonate
GC/MS	EPA 8270C/D	Ethyl parathion
GC/MS	EPA 8270C/D	Famfur
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene
GC/MS	EPA 8270C/D	Hexachlorobutadiene
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D	Hexachloroethane
GC/MS	EPA 8270C/D	Hexachlorophene
GC/MS	EPA 8270C/D	Hexachloropropene
GC/MS	EPA 8270C/D	Indeno(1, 2, 3-cd)pyrene
GC/MS	EPA 8270C/D	Isodrin
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Isosafrole
GC/MS	EPA 8270C/D	Kepone
GC/MS	EPA 8270C/D	Methapyriline
GC/MS	EPA 8270C/D	Methyl methanesulfonate
GC/MS	EPA 8270C/D	Methyl parathion
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	n-Nitrosodiethylamine
GC/MS	EPA 8270C/D	n-Nitrosodimethylamine
GC/MS	EPA 8270C/D	n-Nitroso-di-n-butylamine

Form 403.8 – Rev 1 – 4-11-11 Page 31 of 41



Гесhnology	Method	Analyte
GC/MS	EPA 8270C/D	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270C/D	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D	n-Nitrosomethylethylamine
GC/MS	EPA 8270C/D	n-Nitrosomorpholine
GC/MS	EPA 8270C/D	n-Nitrosopiperidine
GC/MS	EPA 8270C/D	n-Nitrosopyrrolidine
GC/MS	EPA 8270C/D	O, O, O-Triethyl phosphorothioate
GC/MS	EPA 8270C/D	o,o-Diethyl o-2-pyrazinyl phosphorothioate
GC/MS	EPA 8270C/D	o-Toluidine
GC/MS	EPA 8270C/D	Pentachlorobenzene
GC/MS	EPA 8270C/D	Pentachloronitrobenzene
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenacetin
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Phorate
GC/MS	EPA 8270C/D	Pronamide
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/MS	EPA 8270C/D	Safrole
GC/MS	EPA 8270C/D	Sulfotepp
GC/MS	EPA 8270C/D	Thionazin
GC/MS	EPA 8270C/D SIM	1,1'-Biphenyl
GC/MS	EPA 8270C/D SIM	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D SIM	1,4-Dioxane
GC/MS	EPA 8270C/D SIM	1-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2,2'-Oxybis(1-chloropropane
GC/MS	EPA 8270C/D SIM	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D SIM	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D SIM	2,4,6-Trichlorophenol

Form 403.8 – Rev 1 – 4-11-11 Page 32 of 41



id and Chemical Waste		
Technology	Method	Analyte
GC/MS	EPA 8270C/D SIM	2,4-Dimethylphenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrophenol
GC/MS	EPA 8270C/D SIM	2,4-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D SIM	2-Chloronaphthalene
GC/MS	EPA 8270C/D SIM	2-Chlorophenol
GC/MS	EPA 8270C/D SIM	2-Methylnaphthalene
GC/MS	EPA 8270C/D SIM	2-Methylphenol
GC/MS	EPA 8270C/D SIM	2-Nitroaniline
GC/MS	EPA 8270C/D SIM	2-Nitrophenol
GC/MS	EPA 8270C/D SIM	3&4-Methylphenol
GC/MS	EPA 8270C/D SIM	3,3'-Dichlorobenzidine
GC/MS	EPA 8270C/D SIM	3-Nitroaniline
GC/MS	EPA 8270C/D SIM	4,6-Dinitro-2-methylphenol
GC/MS	EPA 8270C/D SIM	4-Bromophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D SIM	4-Chloroaniline
GC/MS	EPA 8270C/D SIM	4-Chlorophenyl-phenylether
GC/MS	EPA 8270C/D SIM	4-Nitroaniline
GC/MS	EPA 8270C/D SIM	4-Nitrophenol
GC/MS	EPA 8270C/D SIM	Acenaphthene
GC/MS	EPA 8270C/D SIM	Acenaphthylene
GC/MS	EPA 8270C/D SIM	Acetophenone
GC/MS	EPA 8270C/D SIM	Anthracene
GC/MS	EPA 8270C/D SIM	Atrazine
GC/MS	EPA 8270C/D SIM	Benzaldehyde
GC/MS	EPA 8270C/D SIM	Benzo(a)anthracene
GC/MS	EPA 8270C/D SIM	Benzo(a)pyrene
GC/MS	EPA 8270C/D SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D SIM	Benzo(k)fluoranthene

Form 403.8 – Rev 1 – 4-11-11 Page 33 of 41



l and Chemical Waste		
Гесhnology	Method	Analyte
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethoxy)methane
GC/MS	EPA 8270C/D SIM	Bis(2-chloroethyl)ether
GC/MS	EPA 8270C/D SIM	Bis(2-ethylhexyl)phthalate
GC/MS	EPA 8270C/D SIM	Butylbenzylphthalate
GC/MS	EPA 8270C/D SIM	Caprolactam
GC/MS	EPA 8270C/D SIM	Carbazole
GC/MS	EPA 8270C/D SIM	Chrysene
GC/MS	EPA 8270C/D SIM	Dibenzo(a,h)anthracene
GC/MS	EPA 8270C/D SIM	Dibenzofuran
GC/MS	EPA 8270C/D SIM	Diethylphthalate
GC/MS	EPA 8270C/D SIM	Dimethyl phthalate
GC/MS	EPA 8270C/D SIM	Di-n-butylphthalate
GC/MS	EPA 8270C/D SIM	Di-n-octylphthalate
GC/MS	EPA 8270C/D SIM	Fluoranthene
GC/MS	EPA 8270C/D SIM	Fluorene
GC/MS	EPA 8270C/D SIM	Hexachlorobenzene
GC/MS	EPA 8270C/D SIM	Hexachlorobutadiene
GC/MS	EPA 8270C/D SIM	Hexachlorocyclopentadiene
GC/MS	EPA 8270C/D SIM	Hexachloroethane
GC/MS	EPA 8270C/D SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D SIM	Isophorone
GC/MS	EPA 8270C/D SIM	Naphthalene
GC/MS	EPA 8270C/D SIM	Nitrobenzene
GC/MS	EPA 8270C/D SIM	n-Nitroso-di-n-propylamine
GC/MS	EPA 8270C/D SIM	n-Nitrosodiphenylamine
GC/MS	EPA 8270C/D SIM	Pentachlorophenol
GC/MS	EPA 8270C/D SIM	Phenanthrene
GC/MS	EPA 8270C/D SIM	Phenol
GC/MS	EPA 8270C/D SIM	Pyrene
HPLC/UV	EPA 8330A	1 ,3, 5-Trinitrobenzene
HPLC/UV	EPA 8330A	1, 3-Dinitrobenzene

Form 403.8 – Rev 1 – 4-11-11 Page 34 of 41



folid and Chemical Waste		
Technology	Method	Analyte
HPLC/UV	EPA 8330A	2, 4, 6-Trinitrotoluene
HPLC/UV	EPA 8330A	2, 4-Dinitrotoluene
HPLC/UV	EPA 8330A	2, 6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4, 6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene
HPLC/UV	EPA 8330A	Ethylene glycol dinitrate (EGDN)
HPLC/UV	EPA 8330A	Hexahydr-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A MOD	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	EPA 8330A	Tetryl
HPLC/UV	8330B (W/O Soil Grinding)	1, 3, 5-Trinitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	1, 3-Dinitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	2, 4, 6-Trinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2, 4-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2, 6-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2-Amino-4, 6 –Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	2-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	3-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	3,5-Dinitroaniline
HPLC/UV	8330B (W/O Soil Grinding)	4-Amino-2,3-Dinitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	4-Nitrotoluene
HPLC/UV	8330B (W/O Soil Grinding)	Ethylene glycol dinitrate (EGDN)
HPLC/UV	8330B (W/O Soil Grinding)	Hexahydr-1, 3, 5-trinitro-1, 3, 5-triazine (RDX)
HPLC/UV	8330B (W/O Soil Grinding)	Nitrobenzene
HPLC/UV	8330B (W/O Soil Grinding)	Nitroglycerin

Form 403.8 – Rev 1 – 4-11-11 Page 35 of 41



Solid and Chemical Waste		
Technology	Method	Analyte
HPLC/UV	8330B (W/O Soil Grinding)	Octahydro-1, 3, 5, 7-tetrazocine (HMX)
HPLC/UV	8330B (W/O Soil Grinding)	Pentaerythritol Tetranitrate (PETN)
HPLC/UV	8330B (W/O Soil Grinding)	Tetryl
CVAA	EPA 7471B	Mercury
CVAF	EPA 1631E	Low Level Mercury
ICP/AES	EPA 6010B/C	Aluminum
ICP/AES	EPA 6010B/C	Antimony
ICP/AES	EPA 6010B/C	Arsenic
ICP/AES	EPA 6010B/C	Barium
ICP/AES	EPA 6010B/C	Beryllium
ICP/AES	EPA 6010B/C	Boron
ICP/AES	EPA 6010B/C	Cadmium
ICP/AES	EPA 6010B/C	Calcium
ICP/AES	EPA 6010B/C	Chromium
ICP/AES	EPA 6010B/C	Cobalt
ICP/AES	EPA 6010B/C	Copper
ICP/AES	EPA 6010B/C	Iron
ICP/AES	EPA 6010B/C	Lead
ICP/AES	EPA 6010B/C	Magnesium
ICP/AES	EPA 6010B/C	Manganese
ICP/AES	EPA 6010B/C	Molybdenum
ICP/AES	EPA 6010B/C	Nickel
ICP/AES	EPA 6010B/C	Potassium
ICP/AES	EPA 6010B/C	Selenium
ICP/AES	EPA 6010B/C	Silicon
ICP/AES	EPA 6010B/C	Silver
ICP/AES	EPA 6010B/C	Sodium
ICP/AES	EPA 6010B/C	Strontium
ICP/AES	EPA 6010B/C	Thallium
ICP/AES	EPA 6010B/C	Tin
ICP/AES	EPA 6010B/C	Titanium

Form 403.8 – Rev 1 – 4-11-11 Page 36 of 41



olid and Chemical Waste		
Technology	Method	Analyte
ICP/AES	EPA 6010B/C	Vanadium
ICP/AES	EPA 6010B/C	Zinc
ICP/MS	EPA 6020A	Aluminum
ICP/MS	EPA 6020A	Antimony
ICP/MS	EPA 6020A	Arsenic
ICP/MS	EPA 6020A	Barium
ICP/MS	EPA 6020A	Beryllium
ICP/MS	EPA 6020A	Boron
ICP/MS	EPA 6020A	Cadmium
ICP/MS	EPA 6020A	Calcium
ICP/MS	EPA 6020A	Chromium
ICP/MS	EPA 6020A	Cobalt
ICP/MS	EPA 6020A	Copper
ICP/MS	EPA 6020A	Iron
ICP/MS	EPA 6020A	Lead
ICP/MS	EPA 6020A	Magnesium
ICP/MS	EPA 6020A	Manganese
ICP/MS	EPA 6020A	Molybdenum
ICP/MS	EPA 6020A	Nickel
ICP/MS	EPA 6020A	Potassium
ICP/MS	EPA 6020A	Selenium
ICP/MS	EPA 6020A	Silver
ICP/MS	EPA 6020A	Sodium
ICP/MS	EPA 6020A	Strontium
ICP/MS	EPA 6020A	Thallium
ICP/MS	EPA 6020A	Tin
ICP/MS	EPA 6020A	Titanium
ICP/MS	EPA 6020A	Tungsten
ICP/MS	EPA 6020A	Vanadium
ICP/MS	EPA 6020A	Zinc
IC	EPA 9056A	Chloride

Form 403.8 – Rev 1 – 4-11-11 Page 37 of 41



Technology	Method	Analyte
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate as N
IC	EPA 9056A	Nitrite as N
IC	EPA 9056A	Orthophosphate
IC	EPA 9056A	Sulfate
Gravimetric	EPA 9071A; EPA 9071B	Oil and Grease, Oil and Grease with SGT
Physical	EPA 1010A	Ignitability
Physical	EPA 9045D	pH
Titration	EPA SW-846 Chapter 7.3.4	Reactive Sulfide
Titration	Walkley-Black	Total Organic Carbon
IR	Lloyd Kahn	Total organic carbon
Turbidimetric	EPA 9038; ASTM 516-02	Sulfate
UV/VIS	EPA 350.1; SM 4500NH3 H	Ammonia as N
UV/VIS	EPA 9251; SM 4500Cl E	Chloride
UV/VIS	EPA SW-846 Chapter 7.3.4	Reactive Cyanide
UV/VIS	EPA 821/R-91-100	AVS-SEM
UV/VIS	SM 3500Fe D	Ferrous Iron
Cleanup Methods	EPA 3630C	Silica Gel
UV/VIS	EPA 7196	Chromium VI
UV/VIS	EPA 7196A	Chromium VI
UV/VIS	EPA 9012B	Total cyanide
Preparation	Method	Туре
Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Cleanup Methods	EPA 3660B	Sulfur Clean-up
Cleanup Methods	EPA 3620C	Florsil Clean-up
Cleanup Methods	EPA 3630C	Silica Gel Clean-up
Cleanup Methods	EPA 3640A	GPC Clean-up
Organic Preparation	EPA 3540C	Soxhlet Extraction
Organic Preparation	EPA 3545A	Pressurized Fluid Extraction

Form 403.8 – Rev 1 – 4-11-11 Page 38 of 41



Solid and Chemical Waste			
Technology	Method	Analyte	
Organic Preparation	EPA 3546	Microwave Extraction Preparation for EPA 8082A, 8081B and 8270C, D	
Organic Preparation	EPA 3550C	Sonication	
Inorganics Preparation	EPA 3050B	Hotblock	
Inorganics Preparation	EPA 3060A	Alkaline Digestion	
Volatile Organics Preparation	EPA 5035/5035A	Closed System Purge and Trap	

Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	Propene
GC/MS	EPA TO-15	1, 1, 1-Trichloroethane
GC/MS	EPA TO-15	1, 1, 2, 2-Tetrachloroethane
GC/MS	EPA TO-15	1, 1, 2-Trichloroethane
GC/MS	EPA TO-15	1, 1-Dichloroethane
GC/MS	EPA TO-15	1, 1-Dichloroethylene
GC/MS	EPA TO-15	1, 2, 4-Trichlorobenzene
GC/MS	EPA TO-15	1, 2, 4-Trimethylbenzene
GC/MS	EPA TO-15	1, 2-Dibromoethane (EDB)
GC/MS	EPA TO-15	1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)
GC/MS	EPA TO-15	1, 2-Dichlorobenzene
GC/MS	EPA TO-15	1, 2-Dichloroethane
GC/MS	EPA TO-15	1, 2-Dichloroethenes (Total)
GC/MS	EPA TO-15	1, 2-Dichloropropane
GC/MS	EPA TO-15	1, 3, 5-Trimethylbenzene
GC/MS	EPA TO-15	1, 3-Butadiene
GC/MS	EPA TO-15	1, 3-Dichlorobenzene
GC/MS	EPA TO-15	1, 4-Dichlorobenzene
GC/MS	EPA TO-15	1,4-Difluorobenzene
GC/MS	EPA TO-15	1, 4-Dioxane
GC/MS	EPA TO-15	2-Butanone
GC/MS	EPA TO-15	2-Hexanone

Form 403.8 – Rev 1 – 4-11-11 Page 39 of 41



Technology	Method	Analyte
GC/MS	EPA TO-15	2-Propanol
GC/MS	EPA TO-15	4-Ethyltoluene
GC/MS	EPA TO-15	4-Methyl-2-pentanone
GC/MS	EPA TO-15	Acetone
GC/MS	EPA TO-15	Acrolein
GC/MS	EPA TO-15	Benzene
GC/MS	EPA TO-15	Benzyl chloride
GC/MS	EPA TO-15	Bromochloromethane
GC/MS	EPA TO-15	Bromodichloromethane
GC/MS	EPA TO-15	Bromoform
GC/MS	EPA TO-15	Carbon disulfide
GC/MS	EPA TO-15	Carbon tetrachloride
GC/MS	EPA TO-15	Chlorobenzene
GC/MS	EPA TO-15	Chloroethane
GC/MS	EPA TO-15	Chloroform
GC/MS	EPA TO-15	Cis-1, 2-Dichloroethene
GC/MS	EPA TO-15	Cis-1, 3-Dichloropropene
GC/MS	EPA TO-15	Cyclohexane
GC/MS	EPA TO-15	Dibromochloromethane
GC/MS	EPA TO-15	Dichlorodifluoromethane (Freon 12)
GC/MS	EPA TO-15	Ethanol
GC/MS	EPA TO-15	Ethyl acetate
GC/MS	EPA TO-15	Ethylbenzene
GC/MS	EPA TO-15	Hexachlorobutadiene
GC/MS	EPA TO-15	Isopropyl alcohol
GC/MS	EPA TO-15	m, p-Xylene
GC/MS	EPA TO-15	Methyl bromide (Bromomethane)
GC/MS	EPA TO-15	Methyl chloride (Chloromethane)
GC/MS	EPA TO-15	Methyl methacrylate
GC/MS	EPA TO-15	Methyl tert-butyl ether
GC/MS	EPA TO-15	Methylene chloride

Form 403.8 – Rev 1 – 4-11-11 Page 40 of 41



Air		
Technology	Method	Analyte
GC/MS	EPA TO-15	Naphthalene
GC/MS	EPA TO-15	n-Heptane
GC/MS	EPA TO-15	n-Hexane
GC/MS	EPA TO-15	o-Xylene
GC/MS	EPA TO-15	Styrene
GC/MS	EPA TO-15	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA TO-15	Tetrahydrofuran
GC/MS	EPA TO-15	Toluene
GC/MS	EPA TO-15	trans-1, 2-Dichloroethylene
GC/MS	EPA TO-15	trans-1, 3-Dichloropropylene
GC/MS	EPA TO-15	Trichloroethene (Trichloroethylene)
GC/MS	EPA TO-15	Trichlorofluoromethane (Freon 11)
GC/MS	EPA TO-15	1,1,2-Trichloro1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA TO-15	Vinyl acetate
GC/MS	EPA TO-15	Vinyl chloride
GC/MS	EPA TO-15	Xylenes (Total)

Notes:

1) This laboratory offers commercial testing service.

Approved by:

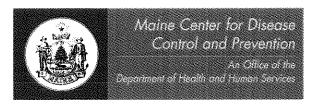
R. Douglas Leonard
Chief Technical Officer

Re-issued: 2/1/13

Date: February 1, 2013

Form 403.8 – Rev 1 – 4-11-11 Page 41 of 41





Department of Health and Human Services Maine Center for Disease Control and Prevention 286 Water Street # 11 State House Station Augusta, Maine 04333-0011

Tel: (207) 287-1929; Fax: (207) 287-4172

(207) 874-2400

Field of Testing Summary for:

Katahdin Analytical Services

600 Technology Way

Scarborough

ME 04074

As required by 22 M.R.S.A Chapter 157-A the laboratory demonstrated the capability to analyze analtyes under 10-144 CMR 263, the rules for laboratory certification and is hereby granted certification for:

Sulfate

EPA 1010A

Ignitability

Ignitability

EPA 120.1

Conductivity EPA 1311

Extraction/Preparation

Extraction/Preparation

EPA 1312

Extraction/Preparation

Extraction/Preparation

EPA 1631E

Mercury

EPA 1664A Oil & Grease

EPA 1664A (HEM)

n-Hexane Extractable Material (O&G)

EPA 180.1 2

Turbidity

EPA 200.7 4.4

Aluminum Aluminum

Antimony

Arsenic

Barium

Barium

Beryllium Beryllium

Boron

Cadmium

Cadmium

Calcium

Calcium

Chromium Chromium

Cobalt

Copper

Copper

Iron

Clean Water Program (NPW)

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Clean Water Program (NPW)

Resource Conservation Recovery Program (NPW)

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Certificate Number: 2014018

FOT Issue Date:

6/1/2014

Expiration Date: 6/1/2016 Jennifer Jamison, Certification Officer

Page 1 of 35

Lead Clean Water Program (NPW) Magnesium Clean Water Program (NPW) Magnesium Safe Drinking Water Program (DW) Manganese Clean Water Program (NPW) Manganese Safe Drinking Water Program (DW) Molybdenum Clean Water Program (NPW) Nickel Clean Water Program (NPW) Nickel Safe Drinking Water Program (DW) Potassium Clean Water Program (NPW) Selenium Clean Water Program (NPW) Silica as SiO2 Clean Water Program (NPW) Silica as SiO2 Safe Drinking Water Program (DW) Silver Clean Water Program (NPW) Silver Safe Drinking Water Program (DW) Sodium Clean Water Program (NPW) Sodium Safe Drinking Water Program (DW) Thellium Clean Water Program (NPW) Tin Clean Water Program (NPW) Vanadium Clean Water Program (NPW) Zinc Clean Water Program (NPW) Zinc Safe Drinking Water Program (DW) EPA 200.8 5.4 Aluminum Clean Water Program (NPW) Aluminum Safe Drinking Water Program (DW) Antimony Clean Water Program (NPW) Antimony Safe Drinking Water Program (DW) Arsenic Clean Water Program (NPW) Arsenic Safe Drinking Water Program (DW) Barium Clean Water Program (NPW) Barium Safe Drinking Water Program (DW) Beryllium Clean Water Program (NPW) Beryllium Safe Drinking Water Program (DW) Clean Water Program (NPW) Cadmium Safe Drinking Water Program (DW) Calcium Clean Water Program (NPW) Chromium Clean Water Program (NPW) Chromium Safe Drinking Water Program (DW) Cobalt Clean Water Program (NPW) Copper Clean Water Program (NPW) Copper Safe Drinking Water Program (DW) Lead Clean Water Program (NPW) Lead Safe Drinking Water Program (DW) Manganese Clean Water Program (NPW) Manganese Safe Drinking Water Program (DW) Molybdenum Clean Water Program (NPW) Nickel Clean Water Program (NPW) Nickel Safe Drinking Water Program (DW) Selenium Clean Water Program (NPW) Selenium Safe Drinking Water Program (DW) Silver Clean Water Program (NPW) Silver Safe Drinking Water Program (DW) Thallium Clean Water Program (NPW) Thallium Safe Drinking Water Program (DW) Uranium Safe Drinking Water Program (DW) Vanadium Clean Water Program (NPW) Zinc Clean Water Program (NPW) Zinc Safe Drinking Water Program (DW) EPA 245.1 3 Mercury Clean Water Program (NPW) Mercury Safe Drinking Water Program (DW) EPA 300.0 2.1

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Jennifer Jamison, Certification Officer

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Page 2 of 35

Bromide Clean Water Program (NPW) Bromide Safe Drinking Water Program (DW) Chloride Clean Water Program (NPW) Chloride Safe Drinking Water Program (DW) Fluoride Clean Water Program (NPW) Fluoride Safe Drinking Water Program (DW) Nitrate as N Clean Water Program (NPW) Nitrate as N Safe Drinking Water Program (DW) Nitrite as N Clean Water Program (NPW) Nitrite as N Safe Drinking Water Program (DW) Orthophosphate as P Clean Water Program (NPW) Orthophosphate as P Safe Drinking Water Program (DW) Sulfate Clean Water Program (NPW) Sulfate Safe Drinking Water Program (DW) EPA 3005A Extraction/Preparation EPA 3050A

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Resource Conservation Recovery Program (S)

Extraction/Preparation Resource Conservation Recovery Program (S)

EPA 3050B Extraction/Preparation Resource Conservation Recovery Program (S)

EPA 3060A

EPA 335.4

Total Cyanide Clean Water Program (NPW) Total Cyanide Safe Drinking Water Program (DW) EPA 350.1 2

Ammonia as N Clean Water Program (NPW) EPA 351.2 2

Kjeldahl nitrogen - total Clean Water Program (NPW)

EPA 3510C Extraction/Preparation Resource Conservation Recovery Program (NPW)

EPA 3520C Extraction/Preparation Resource Conservation Recovery Program (NPW)

EPA 353.2 2 Nitrate as N Clean Water Program (NPW) Nitrate as N Safe Drinking Water Program (DW) Nitrite as N Clean Water Program (NPW) Nitrite as N Safe Drinking Water Program (DW)

Extraction/Preparation Resource Conservation Recovery Program (NPW) Extraction/Preparation Resource Conservation Recovery Program (S)

EPA 3540C

Extraction/Preparation Resource Conservation Recovery Program (S) EPA 3545A Extraction/Preparation Resource Conservation Recovery Program (S)

EPA 3546

Extraction/Preparation Resource Conservation Recovery Program (NPW) Extraction/Preparation Resource Conservation Recovery Program (S)

EPA 3550C

Extraction/Preparation Resource Conservation Recovery Program (S) EPA 3580A

EPA 3585 Extraction/Preparation Resource Conservation Recovery Program (NPW)

Extraction/Preparation Resource Conservation Recovery Program (S) EPA 3640A

Extraction/Preparation Resource Conservation Recovery Program (S) EPA 365.4

Phosphorus, total Clean Water Program (NPW)

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Extraction/Preparation

EPA 3535A

Extraction/Preparation

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Page 3 of 35 **Expiration Date:** 6/1/2016

EPA 3660B Extraction

Extraction/Preparation

EPA 410.4 2

Chemical oxygen demand

EPA 420.1

Total Phenolics

EPA 5030B

Extraction/Preparation Extraction/Preparation

EPA 5035

Extraction/Preparation Extraction/Preparation

EPA 504.1 1.1

1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (EDB, Ethylene dibromide)

EPA 524.2 4.1

1,1,1-Trichloroethane
1,1,2-Trichloroethane
1,1-Dichloroethylene
1,2-A-Trichlorobenzene
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,4-Dichlorobenzene
1,4-Dichlorobenzene

Benzene
Bromodichloromethane
Bromoform
Carbon tetrachloride
Chlorobenzene
Chloroform
cis-1,2-Dichloroethylene

Dibromochloromethane

Dichloromethane (Methylene chloride) Ethylbenzene Hexachlorobutadiene Methyl tert-butyl ether (MTBE)

Styrene

Tetrachloroethylene Toluene Total Trihalomethanes

trans-1,2-Dicloroethylene
Trichloroethene (Trichloroethylene)
Vinyl chloride

Xylene (total) EPA 6010B

Aluminum
Aluminum
Antimony
Antimony
Ansenic
Arsenic
Barium
Beryllium
Beryllium

Boron Cadmium Cadmium Calcium

Boron

Resource Conservation Recovery Program (S)

Clean Water Program (NPW)

Clean Water Program (NPW)

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)

Safe Drinking Water Program (DW) Safe Drinking Water Program (DW)

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Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

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Page 4 of 35

O-tel: —	Decree Occupation Company
Calcium Chromium	Resource Conservation Recovery Program (S)
Chromium	Resource Conservation Recovery Program (NPW)
¥	Resource Conservation Recovery Program (S)
Cobalt Cobalt	Resource Conservation Recovery Program (NPW)
Copper	Resource Conservation Recovery Program (S)
	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Copper Hardness (calc.)	Resource Conservation Recovery Program (NPW)
Iron	Resource Conservation Recovery Program (NPW)
Iron	Resource Conservation Recovery Program (NP VV)
Lead	Resource Conservation Recovery Program (NPW)
Lead	Resource Conservation Recovery Program (8)
Magnesium	Resource Conservation Recovery Program (NPW)
Magnesium	Resource Conservation Recovery Program (S)
Manganese	Resource Conservation Recovery Program (NPW)
Manganese	Resource Conservation Recovery Program (S)
Molybdenum	Resource Conservation Recovery Program (NPW)
Molybdenum	Resource Conservation Recovery Program (S)
Nickel	Resource Conservation Recovery Program (NPW)
Nickel	Resource Conservation Recovery Program (S)
Potassium	Resource Conservation Recovery Program (NPW)
Potassium	Resource Conservation Recovery Program (S)
Selenium	Resource Conservation Recovery Program (NPW)
Selenium	Resource Conservation Recovery Program (S)
Silicon	Resource Conservation Recovery Program (NPW)
Silicon	Resource Conservation Recovery Program (S)
Silver	Resource Conservation Recovery Program (NPW)
Silver	Resource Conservation Recovery Program (S)
Sodium	Resource Conservation Recovery Program (NPW)
Sodium	Resource Conservation Recovery Program (S)
Strontium	Resource Conservation Recovery Program (NPW)
Strontium	Resource Conservation Recovery Program (S)
Thallium	Resource Conservation Recovery Program (NPW)
Thallium	Resource Conservation Recovery Program (S)
Tin	Resource Conservation Recovery Program (NPW)
Tin	Resource Conservation Recovery Program (S)
Titanium	Resource Conservation Recovery Program (NPW)
Titanium	Resource Conservation Recovery Program (\$)
Vanadium	Resource Conservation Recovery Program (NPW)
Vanadium	Resource Conservation Recovery Program (S)
Zinc	Resource Conservation Recovery Program (NPW)
Zinc	Resource Conservation Recovery Program (S)
EPA 6010C	
Aluminum	Resource Conservation Recovery Program (NPW)
Aluminum	Resource Conservation Recovery Program (S)
Antimony	Resource Conservation Recovery Program (NPW)
Antimony	Resource Conservation Recovery Program (S)
Arsenic	Resource Conservation Recovery Program (NPW)
Arsenic	Resource Conservation Recovery Program (S)
Barium	Resource Conservation Recovery Program (NPW)
Barium	Resource Conservation Recovery Program (\$)
Beryllium	Resource Conservation Recovery Program (NPW)
Beryllium	Resource Conservation Recovery Program (S)
Boron	Resource Conservation Recovery Program (NPW)
Boron Cadmium	Resource Conservation Recovery Program (S)
Cadmium	Resource Conservation Recovery Program (NPW)
Cadmium	Resource Conservation Recovery Program (S)
Calcium	Resource Conservation Recovery Program (NPW)
Calcium	Resource Conservation Recovery Program (S)
Chromium Chromium	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Sironium	resource conservation recovery modiam (2)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 5 of 35

Cobalt	Resource Conservation Recovery Program (NPW)
Cobalt	Resource Conservation Recovery Program (S)
Copper	Resource Conservation Recovery Program (NPW)
Capper	Resource Conservation Recovery Program (S)
Iron	Resource Conservation Recovery Program (NPW)
Iron	Resource Conservation Recovery Program (S)
Lead	Resource Conservation Recovery Program (NPW)
Lead	Resource Conservation Recovery Program (S)
Magnesium	Resource Conservation Recovery Program (NPW)
Magnesium	Resource Conservation Recovery Program (S)
Manganese	Resource Conservation Recovery Program (NPW)
Manganese	Resource Conservation Recovery Program (S)
Molybdenum	Resource Conservation Recovery Program (NPW)
Molybdenum Niekol	Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)
Nickel Nickel	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Potassium	Resource Conservation Recovery Program (NPW)
Potassium	Resource Conservation Recovery Program (NPVV)
Selenium	Resource Conservation Recovery Program (NPW)
Selenium	Resource Conservation Recovery Program (\$)
Silicon	Resource Conservation Recovery Program (NPW)
Silicon	Resource Conservation Recovery Program (S)
Silver	Resource Conservation Recovery Program (NPW)
Silver	Resource Conservation Recovery Program (S)
Sodium	Resource Conservation Recovery Program (NPW)
Sodium	Resource Conservation Recovery Program (S)
Strontium	Resource Conservation Recovery Program (NPW)
Strontium	Resource Conservation Recovery Program (S)
Thallium	Resource Conservation Recovery Program (NPW)
Thallium	Resource Conservation Recovery Program (S)
Tin 	Resource Conservation Recovery Program (NPW)
Tin	Resource Conservation Recovery Program (S)
Titanium Titanium	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Vanadium	Resource Conservation Recovery Program (NPW)
Vanadium	Resource Conservation Recovery Program (S)
Zinc	Resource Conservation Recovery Program (NPW)
Zinc	Resource Conservation Recovery Program (S)
EPA 6020	
Atuminum	Resource Conservation Recovery Program (NPW)
Aluminum	Resource Conservation Recovery Program (S)
Antimony	Resource Conservation Recovery Program (NPW)
Antimony	Resource Conservation Recovery Program (S)
Arsenic	Resource Conservation Recovery Program (NPW)
Arsenic	Resource Conservation Recovery Program (S)
Barium	Resource Conservation Recovery Program (NPW)
Barium	Resource Conservation Recovery Program (S)
Beryllium	Resource Conservation Recovery Program (NPW)
Beryllium	Resource Conservation Recovery Program (S)
Boron	Resource Conservation Recovery Program (NPW)
Boron	Resource Conservation Recovery Program (S)
Cadmium	Resource Conservation Recovery Program (NPW)
Cadmium	Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)
Calcium Calcium	Resource Conservation Recovery Program (NPVV) Resource Conservation Recovery Program (S)
Chromium	Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)
Chromium	Resource Conservation Recovery Program (NPVV)
Cobalt	Resource Conservation Recovery Program (NPW)
Cobalt	Resource Conservation Recovery Program (S)
Copper	Resource Conservation Recovery Program (NPW)
Copper	Resource Conservation Recovery Program (S)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 6 of 35

Resource Conservation Recovery Program (NPW) Iron Iron Resource Conservation Recovery Program (S) Lead Resource Conservation Recovery Program (NPW) Lead Resource Conservation Recovery Program (S) Magnesium Resource Conservation Recovery Program (NPW) Magnesium Resource Conservation Recovery Program (S) Manganese Resource Conservation Recovery Program (NPW) Manganese Resource Conservation Recovery Program (S) Molybdenum Resource Conservation Recovery Program (NPW) Molybdenum Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Nickel Nickel Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Potassium Potassium Resource Conservation Recovery Program (S) Selenium Resource Conservation Recovery Program (NPW) Selenium Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Silver Resource Conservation Recovery Program (S) Sodium Resource Conservation Recovery Program (NPW) Sodium Resource Conservation Recovery Program (S) Strontium Resource Conservation Recovery Program (NPW) Strontium Resource Conservation Recovery Program (S) Thallium Resource Conservation Recovery Program (NPW) Thallium Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Tin Resource Conservation Recovery Program (S) Tin Uranium Resource Conservation Recovery Program (NPW) Uranium Resource Conservation Recovery Program (S) Vanadium Resource Conservation Recovery Program (NPW) Vanadium Resource Conservation Recovery Program (S) Zinc Resource Conservation Recovery Program (NPW) Zinc Resource Conservation Recovery Program (S) EPA 6020A Aluminum Resource Conservation Recovery Program (NPW) Aluminum Resource Conservation Recovery Program (S) Antimony Resource Conservation Recovery Program (NPW) Antimony Resource Conservation Recovery Program (S) Arsenic Resource Conservation Recovery Program (NPW) Arsenic Resource Conservation Recovery Program (S) Barium Resource Conservation Recovery Program (NPW) Barium Resource Conservation Recovery Program (S) Bervillium Resource Conservation Recovery Program (NPW) Beryllium Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Boron Boron Resource Conservation Recovery Program (S) Cadmium Resource Conservation Recovery Program (NPW) Cadmium Resource Conservation Recovery Program (S) Calcium Resource Conservation Recovery Program (NPW) Calcium Resource Conservation Recovery Program (S) Chromium Resource Conservation Recovery Program (NPW) Chromium Resource Conservation Recovery Program (S) Cobalt Resource Conservation Recovery Program (NPW) Cobalt Resource Conservation Recovery Program (S) Copper Resource Conservation Recovery Program (NPW) Copper Resource Conservation Recovery Program (S) Iron Resource Conservation Recovery Program (NPW) Iron Resource Conservation Recovery Program (S) Lead Resource Conservation Recovery Program (NPW) Lead Resource Conservation Recovery Program (S) Magnesium Resource Conservation Recovery Program (NPW) Magnesium Resource Conservation Recovery Program (S)

To be considered valid, this Fields of Testing Summary must be displayed with a current certificate.

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 7 of 35

Manganese	Resource Conservation Recovery Program (NPW)
Manganese	Resource Conservation Recovery Program (S)
Molybdenum	Resource Conservation Recovery Program (NPW)
Molybdenum	Resource Conservation Recovery Program (S)
Nickel	Resource Conservation Recovery Program (NPW)
Nickel	Resource Conservation Recovery Program (S)
Potassium	Resource Conservation Recovery Program (NPW)
Potassium	Resource Conservation Recovery Program (S)
Selenium	Resource Conservation Recovery Program (NPW)
Selenium	Resource Conservation Recovery Program (S)
Silicon	Resource Conservation Recovery Program (NPW)
Silicon	Resource Conservation Recovery Program (S)
Silver	Resource Conservation Recovery Program (NPW)
Silver	Resource Conservation Recovery Program (S)
Sodium	Resource Conservation Recovery Program (NPW)
Sodium	Resource Conservation Recovery Program (S)
Strontium	Resource Conservation Recovery Program (NPW)
Strontium	Resource Conservation Recovery Program (S)
Thallium	Resource Conservation Recovery Program (NPW)
Thallium	Resource Conservation Recovery Program (S)
Tin	Resource Conservation Recovery Program (NPW)
Tin	Resource Conservation Recovery Program (S)
Uranium	Resource Conservation Recovery Program (NPW)
Uranium	Resource Conservation Recovery Program (S)
Vanadium	Resource Conservation Recovery Program (NPW)
Vanadium	Resource Conservation Recovery Program (S)
Zinc	Resource Conservation Recovery Program (NPW)
Zinc	Resource Conservation Recovery Program (S)
EPA 608	
4,4'-DDD	Clean Water Program (NPW)
4,4'-DDE	Clean Water Program (NPW)
4,4'-DDT	Clean Water Program (NPW)
Aldrin	Clean Water Program (NPW)
alpha-BHC	Clean Water Program (NPW)
Aroclor-1016 (PCB-1016)	Clean Water Program (NPW)
Aroclor-1221 (PCB-1221)	Clean Water Program (NPW)
Arodor-1232 (PCB-1232)	Clean Water Program (NPW)
Aroclor-1242 (PCB-1242)	Clean Water Program (NPW)
Arocior-1248 (PCB-1248)	Clean Water Program (NPW)
Aroclor-1254 (PCB-1254)	Clean Water Program (NPW)
Aroclor-1260 (PCB-1260)	Clean Water Program (NPW)
beta-BHC	Clean Water Program (NPW)
Chlordane (tech.)	Clean Water Program (NPW)
delta-BHC	Clean Water Program (NPW)
Dieldrin	Clean Water Program (NPW)
Endosulfan I	Clean Water Program (NPW)
Endosulfan II	Clean Water Program (NPW)
Endosulfan sulfate	Clean Water Program (NPW)
Endrin	Clean Water Program (NPW)
Endrin aldehyde	<u> </u>
gamma-BHC	Clean Water Program (NPW)
-	Clean Water Program (NPW)
Heptachlor Heptachlor epoxide	Clean Water Program (NPW)
•	Clean Water Program (NPW)
Toxaphene	Clean Water Program (NPW)
EPA 624	
1,1,1-Trichloroethane	Clean Water Program (NPW)
1,1,2,2-Tetrachloroethane	Clean Water Program (NPW)
1,1,2-Trichloroethane	Clean Water Program (NPW)
1,1-Dichloroethane	Clean Water Program (NPW)
1,1-Dichloroethylene	Clean Water Program (NPW)
1,2-Dichlorobenzene	Clean Water Program (NPW)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 8 of 35

1.2-Dichloroethane	Close Mister Broarem (NBM)
1,2-Dichloropropane	Clean Water Program (NPW) Clean Water Program (NPW)
1,3-Dichlorobenzene	Clean Water Program (NPW)
1,4-Dichlorobenzene	Clean Water Program (NPW)
2-Chloroethyl vinyl ether	Clean Water Program (NPW)
Acrolein	Clean Water Program (NPW)
Acrylonitrile	Clean Water Program (NPW)
Benzene	Clean Water Program (NPW)
Bromodichloromethane	Clean Water Program (NPW)
Bromoform	Clean Water Program (NPW)
Bromomethane (Methyl bromide)	Clean Water Program (NPW)
Carbon tetrachloride	Clean Water Program (NPW)
Chlorobenzene	Clean Water Program (NPW)
Chloroethane	Clean Water Program (NPW)
Chloroform	Clean Water Program (NPW)
cis-1,3-Dichloropropene	Clean Water Program (NPW)
Dibromochloromethane	Clean Water Program (NPW)
Dichlorodifluoromethane	Clean Water Program (NPW)
Dichloromethane (Methylene chloride)	Clean Water Program (NPW)
Ethylbenzene	Clean Water Program (NPW)
Methyl chloride (Chloromethane)	Clean Water Program (NPW)
Tetrachioroethylene	Clean Water Program (NPW)
Toluene	Clean Water Program (NPW)
trans-1,2-Dicloroethylene	Clean Water Program (NPW)
trans-1,3-Dichloropropylene	Clean Water Program (NPW)
Trichloroethene (Trichloroethylene)	Clean Water Program (NPW)
Trichlorofluoromethane	Clean Water Program (NPW)
Vinyl chloride	Clean Water Program (NPW)
EPA 625	
1,2,4-Trichlorobenzene	Clean Water Program (NPW)
1,2-Diphenylhydrazine	Clean Water Program (NPW)
2,4,6-Trichlorophenol	Clean Water Program (NPW)
2,4-Dichlorophenol	Clean Water Program (NPW)
2,4-Dimethylphenol	Clean Water Program (NPW)
2,4-Dinitrophenol	Clean Water Program (NPW)
2,4-Dinitrotoluene (2,4-DNT)	Clean Water Program (NPW)
2,6-Dinitrotoluene (2,6-DNT)	Clean Water Program (NPW)
2-Chloronaphthalene	Clean Water Program (NPW)
2-Chlorophenoi	Clean Water Program (NPW)
2-Nitrophenol	Clean Water Program (NPW)
3,3'-Dichlorobenzidine	Clean Water Program (NPW)
4,6-Dinitro-2-methylphenol	Clean Water Program (NPW)
4-Bromophenyl phenyl ether	Clean Water Program (NPW)
4-Chloro-3-methylphenol	Clean Water Program (NPW)
4-Chlorophenyl phenylether	Clean Water Program (NPW)
4-Nitrophenol	Clean Water Program (NPW)
Acenaphthene	Clean Water Program (NPW)
Acenaphthylene	Clean Water Program (NPW)
Anthracene	Clean Water Program (NPW)
Benzidine	Clean Water Program (NPW)
Benzo[a]anthracene	Clean Water Program (NPW)
Benzo[a]pyrene	Clean Water Program (NPW)
Benzo[b]fluoranthene	Clean Water Program (NPW)
Benzo[g,h,i]perylene	Clean Water Program (NPW)
Benzo[k]fluoranthene	Clean Water Program (NPW)
bis(2-Chloroethoxy)methane	Clean Water Program (NPW)
bis(2-Chloroethyl)ether	Clean Water Program (NPW)
bis(2-Chloroisopropyl)ether	Clean Water Program (NPW)
bis(2-Ethylhexyl)phthalate (DEHP)	Clean Water Program (NPW)
Butyl benzyl phthaiate	Clean Water Program (NPW)
Chrysene	Clean Water Program (NPW)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 9 of 35

Dibenz[a,h]anthracene	Clean Water Program (NPW)
Diethyl phthalate	Clean Water Program (NPW)
Dimethyl phthalate	Clean Water Program (NPW)
Di-n-butyl phthalate	Clean Water Program (NPW)
Di-n-octyl phthalate	Clean Water Program (NPW)
Fluoranthene	Clean Water Program (NPW)
Fluorene	Clean Water Program (NPW)
Hexachlorobenzene	Clean Water Program (NPW)
Hexachlorobutadiene	Clean Water Program (NPW)
Hexachlorocyclopentadiene	Clean Water Program (NPW)
Hexachioroethane	Clean Water Program (NPW)
Indeno[1,2,3-cd]pyrene	Clean Water Program (NPW)
Isophorone	Clean Water Program (NPW)
Naphthalene	Clean Water Program (NPW)
Nitrobenzene	Clean Water Program (NPW)
n-Nitrosodimethylamine	Clean Water Program (NPW)
n-Nitroso-di-n-propylamine	Clean Water Program (NPW)
n-Nitrosodiphenylamine	Clean Water Program (NPW)
Pentachlorophenol	Clean Water Program (NPW)
Phenanthrene Phenol	Clean Water Program (NPW)
Pyrene	Clean Water Program (NPW)
•	Clean Water Program (NPW)
EPA 7196A 1	Daniel Communication Communica
Chromium VI	Resource Conservation Recovery Program (NPW)
Chromium VI	Resource Conservation Recovery Program (S)
EPA 7470A	
Mercury	Resource Conservation Recovery Program (NPW)
EPA 7471A	
Mercury	Resource Conservation Recovery Program (S)
EPA 7471B	
Mercury	Resource Conservation Recovery Program (S)
EPA 8011	
1,2-Dibromoethane (EDB, Ethylene dibromide)	Resource Conservation Recovery Program (NPW)
Dibromochloropropane	Resource Conservation Recovery Program (NPW)
EPA 8015B	
Ethylene glycol	Resource Conservation Recovery Program (S)
Propylene Glycol	Resource Conservation Recovery Program (NPW)
Propylene Glycol	Resource Conservation Recovery Program (S)
EPA 8015C	
Ethanol	Resource Conservation Recovery Program (NPW)
Ethylene glycol	Resource Conservation Recovery Program (NPW)
Ethylene glycol	Resource Conservation Recovery Program (S)
isopropanol	Resource Conservation Recovery Program (NPW)
Methanol	Resource Conservation Recovery Program (NPW)
Propylene Glycol	Resource Conservation Recovery Program (NPW)
EPA 8081A	
4,4'-DDD	Resource Conservation Recovery Program (NPW)
4,4'~DDD	Resource Conservation Recovery Program (S)
4,4'-DDE	Resource Conservation Recovery Program (NPW)
4,4'-DDE	Resource Conservation Recovery Program (S)
4,4'-DDT	Resource Conservation Recovery Program (NPW)
4,4'-DDT	Resource Conservation Recovery Program (S)
Aldrin	Resource Conservation Recovery Program (NPW)
Aldrin	Resource Conservation Recovery Program (S)
alpha-BHC	Resource Conservation Recovery Program (NPW)
alpha-BHC	Resource Conservation Recovery Program (S)
alpha-Chlordane	Resource Conservation Recovery Program (NPW)
alpha-Chlordane	Resource Conservation Recovery Program (S)
beta-BHC	Resource Conservation Recovery Program (NPW)
beta-BHC	Resource Conservation Recovery Program (S)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 10 of 35

Chlordane (tech.)	Resource Conservation Recovery Program (NPW)
Chlordane (tech.)	Resource Conservation Recovery Program (S)
delta-BHC	Resource Conservation Recovery Program (NPW)
delta-BHC	Resource Conservation Recovery Program (S)
Dieldrin	Resource Conservation Recovery Program (NPW)
Dieldrin	Resource Conservation Recovery Program (S)
Endosulfan I	Resource Conservation Recovery Program (NPW)
Endosulfan I	Resource Conservation Recovery Program (S)
Endosulfan II	Resource Conservation Recovery Program (NPW)
Endosulfan II	Resource Conservation Recovery Program (S)
Endosulfan sulfate	Resource Conservation Recovery Program (NPW)
Endosulfan sulfate	Resource Conservation Recovery Program (S)
Endrin	Resource Conservation Recovery Program (NPW)
Endrin	Resource Conservation Recovery Program (S)
Endrin aldehyde	Resource Conservation Recovery Program (NPW)
Endrin aldehyde	Resource Conservation Recovery Program (S)
Endrin ketone	Resource Conservation Recovery Program (NPW)
Endrin ketone gamma-BHC	Resource Conservation Recovery Program (S)
gamma-BHC	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
gamma-Chlordane	Resource Conservation Recovery Program (NPW)
gamma-Chlordane	Resource Conservation Recovery Program (Nr W)
Heptachlor	Resource Conservation Recovery Program (NPW)
Heptachlor	Resource Conservation Recovery Program (S)
Heptachlor epoxide	Resource Conservation Recovery Program (NPW)
Heptachlor epoxide	Resource Conservation Recovery Program (S)
Methoxychior	Resource Conservation Recovery Program (NPW)
Methoxychlor	Resource Conservation Recovery Program (S)
Toxaphene	Resource Conservation Recovery Program (NPW)
Toxaphene	Resource Conservation Recovery Program (S)
EPA 8081B	······································
4,4'-DDD	Resource Conservation Recovery Program (NPW)
4,4'-DDD	Resource Conservation Recovery Program (S)
4.4'-DDE	Resource Conservation Recovery Program (NPW)
4,4'-DDE	Resource Conservation Recovery Program (S)
4,4'-DDT	Resource Conservation Recovery Program (NPW)
4,4'-DDT	Resource Conservation Recovery Program (S)
Aldrin	Resource Conservation Recovery Program (NPW)
Aldrin	Resource Conservation Recovery Program (S)
alpha-BHC	Resource Conservation Recovery Program (NPW)
alpha-BHC	Resource Conservation Recovery Program (S)
alpha-Chlordane	Resource Conservation Recovery Program (NPW)
alpha-Chiordane	Resource Conservation Recovery Program (S)
beta-BHC	Resource Conservation Recovery Program (NPW)
beta-BHC	Resource Conservation Recovery Program (S)
Chlordane (tech.)	Resource Conservation Recovery Program (NPW)
Chlordane (tech.)	Resource Conservation Recovery Program (S)
delta-BHC	Resource Conservation Recovery Program (NPW)
delta-BHC	Resource Conservation Recovery Program (S)
Dieldrin	Resource Conservation Recovery Program (NPW)
Dieldrin	Resource Conservation Recovery Program (S)
Endosulfan I	Resource Conservation Recovery Program (NPW)
Endosulfan I	Resource Conservation Recovery Program (S)
Endosulfan II	Resource Conservation Recovery Program (NPW)
Endosulfan II	Resource Conservation Recovery Program (S)
Endosulfan sulfate	Resource Conservation Recovery Program (NPW)
Endosulfan sulfate	Resource Conservation Recovery Program (S)
Endrin	Resource Conservation Recovery Program (NPW)
Endrin	Resource Conservation Recovery Program (S)
Endrin aldehyde	Resource Conservation Recovery Program (NPW)
Endrin aldehyde	Resource Conservation Recovery Program (S)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 11 of 35

	Endrin ketone	Resource Conservation Recovery Program (NPW)
	Endrin ketone	Resource Conservation Recovery Program (S)
	gamma-BHC	Resource Conservation Recovery Program (NPW)
	gamma-BHC	Resource Conservation Recovery Program (S)
	gamma-Chlordane	Resource Conservation Recovery Program (NPW)
	gamma-Chlordane	Resource Conservation Recovery Program (S)
	Heptachlor	Resource Conservation Recovery Program (NPW)
	Heptachlor	Resource Conservation Recovery Program (S)
	Heptachlor epoxide	Resource Conservation Recovery Program (NPW)
	Heptachlor epoxide	Resource Conservation Recovery Program (S)
	Methoxychlor	Resource Conservation Recovery Program (NPW)
	Methoxychlor	Resource Conservation Recovery Program (S)
	Toxaphene	Resource Conservation Recovery Program (NPW)
	Toxaphene	Resource Conservation Recovery Program (S)
EF	A 8082	
	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,3',4,4',5,6-Octachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,3',4,4',5,6-Octachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,3',4,4',5-Heptachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,3',4,4',5-Heptachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,3',4,4'-Hexachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,3',4,4'-Hexachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,4,4',5,5'-Heptachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,4,4',5,5'-Heptachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,4,4',5',6-Heptachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,4,4',5',6-Heptachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,4',5,5',6-Heptachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,4',5,5',6-Heptachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,4',5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,4',5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,4,5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,4,5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',3,5'-Tetrachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',3,5'-Tetrachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',4,4',5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',4,4',5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',4,5,5'-Pentachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',4,5,5'-Pentachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',5,5'-Tetrachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',5,5'-Tetrachiorobiphenyl	Resource Conservation Recovery Program (S)
	2,2',5-Trichlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,2',5-Trichlorobiphenyl	Resource Conservation Recovery Program (S)
	2,3,3',4,4',5,5'-Heptachlorobiphenyi	Resource Conservation Recovery Program (NPW)
	2,3,3';4,4',5,5'-Heptachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,3,3',4,4'-Pentachiorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,3,3°,4,4°-Pentachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,3',4,4',5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,3',4,4',5,5'-Hexachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,3',4,4',5'-Pentachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,3',4,4',5'-Pentachtorobiphenyl	Resource Conservation Recovery Program (S)
	2,3',4,4',5-Pentachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,3',4,4',5-Pentachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,3,4,4',5-Pentachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,3,4,4',5-Pentachlorobiphenyl	Resource Conservation Recovery Program (S)
	2,3',4,4'-Tetrachlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,3',4,4'-Tetrachiorobiphenyl	Resource Conservation Recovery Program (S)
	2,4,4'-Trichlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,4,4'-Trichlorobiphenyl	Resource Conservation Recovery Program (S)
	2,4'-Dichlorobiphenyl	Resource Conservation Recovery Program (NPW)
	2,4'-Dichlorobiphenyl	Resource Conservation Recovery Program (NY W)
		. 1000 to Comon valor (1000 very 1 regrant (0)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 12 of 35

3.3',4,4',5,5'-Hexachlorobiphenyl Resource Conservation Recovery Program (NPW) 3,3',4,4',5,5'-Hexachlorobiphenyl Resource Conservation Recovery Program (S) 3.3'.4.4'.5-Pentachlorobiphenyl Resource Conservation Recovery Program (NPW) 3.3'.4.4'.5-Pentachlorobiphenyl Resource Conservation Recovery Program (S) 3.3'.4.4'-Tetrachlorobiphenyl Resource Conservation Recovery Program (NPW) 3,3',4,4'-Tetrachlorobiphenyl Resource Conservation Recovery Program (S) 3,4,4',5-Tetrachlorobiphenyl Resource Conservation Recovery Program (NPW) 3,4,4',5-Tetrachlorobiphenyl Resource Conservation Recovery Program (S) Arocior-1016 (PCB-1016) Resource Conservation Recovery Program (NPW) Aroclor-1016 (PCB-1016) Resource Conservation Recovery Program (S) Aroclor-1221 (PCB-1221) Resource Conservation Recovery Program (NPW) Aroctor-1221 (PCB-1221) Resource Conservation Recovery Program (S) Aroclor-1232 (PCB-1232) Resource Conservation Recovery Program (NPW) Aroclor-1232 (PCB-1232) Resource Conservation Recovery Program (S) Aroclor-1242 (PCB-1242) Resource Conservation Recovery Program (NPW) Aroclor-1242 (PCB-1242) Resource Conservation Recovery Program (S) Aroclor-1248 (PCB-1248) Resource Conservation Recovery Program (NPW) Aroclor-1248 (PCB-1248) Resource Conservation Recovery Program (S) Aroclor-1254 (PCB-1254) Resource Conservation Recovery Program (NPW) Aroclor-1254 (PCB-1254) Resource Conservation Recovery Program (S) Aroclor-1260 (PCB-1260) Resource Conservation Recovery Program (NPW) Aroclor-1260 (PCB-1260) Resource Conservation Recovery Program (S) Aroclor-1262 (PCB 1262) Resource Conservation Recovery Program (NPW) Aroclor-1262 (PCB 1262) Resource Conservation Recovery Program (S) Aroclor-1268 (PCB-1268) Resource Conservation Recovery Program (NPW) Aroclor-1268 (PCB-1268) Resource Conservation Recovery Program (S) Decachlorobiphenyl Resource Conservation Recovery Program (NPW) Decachlorobiphenyl Resource Conservation Recovery Program (S) **EPA 8082A** 2.2'.3.3'.4.4'.5.5'.6-Nonachlorobiohenvl Resource Conservation Recovery Program (NPW) 2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl Resource Conservation Recovery Program (S) 2.2'.3.4.4'.5'-Hexachlorobiphenyl Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) 2,2',3,4,4',5'-Hexachlorobiphenyl 2,2',3,4',5,5',6-Heptachlorobiphenyl Resource Conservation Recovery Program (NPW) 2,2',3,4',5,5',6-Heptachlorobiphenyl Resource Conservation Recovery Program (S) 2,2',3,5'-Tetrachlorobiphenyl Resource Conservation Recovery Program (NPW) 2,2',3,5'-Tetrachlorobiphenyl Resource Conservation Recovery Program (S) 2,2',4,4',5,5'-Hexachlorobiphenyl Resource Conservation Recovery Program (NPW) 2.2'.4.4'.5.5'-Hexachlorobiphenyl Resource Conservation Recovery Program (S) 2,2',5,5'-Tetrachlorobiphenyl Resource Conservation Recovery Program (NPW) 2,2',5,5'-Tetrachlorobiphenyl Resource Conservation Recovery Program (S) 2,2',5-Trichlorobiphenyl Resource Conservation Recovery Program (NPW) 2,2',5-Trichlorobiphenyl Resource Conservation Recovery Program (S) 2,3,3',4,4',5,5'-Heptachlorobiphenyl Resource Conservation Recovery Program (NPW) 2,3,3',4,4',5,5'-Heptachlorobiphenyl Resource Conservation Recovery Program (S) 2,3',4,4'-Tetrachlorobiphenyl Resource Conservation Recovery Program (NPW) 2,3',4,4'-Tetrachlorobiphenyl Resource Conservation Recovery Program (S) Aroclor-1016 (PCB-1016) Resource Conservation Recovery Program (NPW) Aroclor-1016 (PCB-1016) Resource Conservation Recovery Program (S) Aroclor-1221 (PCB-1221) Resource Conservation Recovery Program (NPW) Amojor-1221 (PCB-1221) Resource Conservation Recovery Program (S) Arocior-1232 (PCB-1232) Resource Conservation Recovery Program (NPW) Aroclor-1232 (PCB-1232) Resource Conservation Recovery Program (S) Aroclor-1242 (PCB-1242) Resource Conservation Recovery Program (NPW) Arocior-1242 (PCB-1242) Resource Conservation Recovery Program (S)

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Aroclor-1248 (PCB-1248)

Aroclor-1248 (PCB-1248)

Aroclor-1254 (PCB-1254)

Aroclor-1254 (PCB-1254)

Aroclor-1260 (PCB-1260)

Aroclor-1260 (PCB-1260)

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Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Resource Conservation Recovery Program (S)

Resource Conservation Recovery Program (S)

Page 13 of 35

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Aroclor-1262 (PCB 1262)	Resource Conservation Recovery Program (NPW)
Arocior-1262 (PCB 1262)	Resource Conservation Recovery Program (S)
Aroclor-1268 (PCB-1268)	Resource Conservation Recovery Program (NPW)
Aroclor-1268 (PCB-1268)	Resource Conservation Recovery Program (S)
EPA 8151A	
2,4,5-T	Resource Conservation Recovery Program (NPW)
2,4,5-T	Resource Conservation Recovery Program (S)
2,4-D	Resource Conservation Recovery Program (NPW)
2,4-D	Resource Conservation Recovery Program (S)
2,4-DB	Resource Conservation Recovery Program (NPW)
2,4-DB	Resource Conservation Recovery Program (S)
Dalapon	Resource Conservation Recovery Program (NPW)
Dalapon	Resource Conservation Recovery Program (S)
Dicamba	Resource Conservation Recovery Program (NPW)
Dicamba	Resource Conservation Recovery Program (S)
Dichloroprop	Resource Conservation Recovery Program (NPW)
Dichloroprop	Resource Conservation Recovery Program (S)
Dinoseb	Resource Conservation Recovery Program (NPW)
Dinoseb	Resource Conservation Recovery Program (S)
MCPA	Resource Conservation Recovery Program (NPW)
MCPA	Resource Conservation Recovery Program (S)
MCPP	Resource Conservation Recovery Program (NPW)
MCPP	Resource Conservation Recovery Program (S)
Pentachlorophenol	Resource Conservation Recovery Program (NPW)
Pentachlorophenol	Resource Conservation Recovery Program (S)
Silvex (2,4,5-TP)	Resource Conservation Recovery Program (NPW)
Silvex (2,4,5-TP)	Resource Conservation Recovery Program (S)
EPA 8260B	
1,1,1,2-Tetrachloroethane	Resource Conservation Recovery Program (NPW)
1,1,1,2-Tetrachioroethane	Resource Conservation Recovery Program (S)
1,1,1-Trichloroethane	Resource Conservation Recovery Program (NPW)
1,1,1-Trichloroethane	Resource Conservation Recovery Program (S)
1,1,2,2-Tetrachioroethane	Resource Conservation Recovery Program (NPW)
1,1,2,2-Tetrachloroethane	Resource Conservation Recovery Program (S)
1,1,2-Trichloro-1,2,2-trifluoroethane	Resource Conservation Recovery Program (NPW)
1,1,2-Trichloro-1,2,2-triffuoroethane	Resource Conservation Recovery Program (S)
1,1,2-Trichloroethane	Resource Conservation Recovery Program (NPW)
1,1,2-Trichloroethane	Resource Conservation Recovery Program (S)
1,1-Dichloroethane	Resource Conservation Recovery Program (NPW)
1,1-Dichloroethane	Resource Conservation Recovery Program (S)
1,1-Dichloroethylene	Resource Conservation Recovery Program (NPW)
1,1-Dichloroethylene	Resource Conservation Recovery Program (S)
1,1-Dichloropropene	Resource Conservation Recovery Program (NPW)
1,1-Dichloropropene	Resource Conservation Recovery Program (New York)
1,2,3-Trichlorobenzene	, ,
1,2,3-Trichloroberizerie	Resource Conservation Recovery Program (NPW)
	Resource Conservation Recovery Program (S)
1,2,3-Trichloropropane	Resource Conservation Recovery Program (NPW)
1,2,3-Trichloropropane	Resource Conservation Recovery Program (S)
1,2,4-Trichlorobenzene	Resource Conservation Recovery Program (NPW)
1,2,4-Trichlorobenzene	Resource Conservation Recovery Program (S)
1,2,4-Trimethylbenzene	Resource Conservation Recovery Program (NPW)
1,2,4-Trimethylbenzene	Resource Conservation Recovery Program (S)
1,2-Dibromo-3-chloropropane (DBCP)	Resource Conservation Recovery Program (NPW)
1,2-Dibromo-3-chloropropane (DBCP)	Resource Conservation Recovery Program (S)
1,2-Dibromoethane (EDB, Ethylene dibromide)	Resource Conservation Recovery Program (NPW)
1,2-Dibromoethane (EDB, Ethylene dibromide)	Resource Conservation Recovery Program (S)
1,2-Dichlorobenzene	Resource Conservation Recovery Program (NPW)
1,2-Dichlorobenzene	Resource Conservation Recovery Program (S)
1,2-Dichloroethane	Resource Conservation Recovery Program (NPW)
1,2-Dichloroethane	Resource Conservation Recovery Program (S)
1,2-Dichloropropane	Resource Conservation Recovery Program (NPW)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 14 of 35

1,2-Dichloropropane Resource Conservation Recovery Program (S) 1,3,5-Trichlorobenzene Resource Conservation Recovery Program (NPW) 1.3.5-Trichlorobenzene Resource Conservation Recovery Program (S) 1,3,5-Trimethylbenzene Resource Conservation Recovery Program (NPW) 1.3.5-Trimethylbenzene Resource Conservation Recovery Program (S) 1,3-Dichlorobenzene Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) 1.3-Dichlorobenzene 1,3-Dichloropropane Resource Conservation Recovery Program (NPW) 1,3-Dichloropropane Resource Conservation Recovery Program (S) 1,4-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1,4-Dichlorobenzene Resource Conservation Recovery Program (S) 1,4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (NPW) 1,4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) 1-Chlorohexane 1-Chlorohexane Resource Conservation Recovery Program (S) 2,2-Dichloropropane Resource Conservation Recovery Program (NPW) 2.2-Dichloropropane Resource Conservation Recovery Program (S) 2-Butanone (Methyl ethyl ketone, MEK) Resource Conservation Recovery Program (NPW) 2-Butanone (Methyl ethyl ketone, MEK) Resource Conservation Recovery Program (S) 2-Chloroethyl vinyl ether Resource Conservation Recovery Program (NPW) 2-Chloroethyl vinyl ether Resource Conservation Recovery Program (S) 2-Chlorotoluene Resource Conservation Recovery Program (NPW) 2-Chlorotoluene Resource Conservation Recovery Program (S) 2-Hexanone Resource Conservation Recovery Program (NPW) 2-Hexanone Resource Conservation Recovery Program (S) 4-Chlorotoluene Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) 4-Chlorotoluene 4-Methyl-2-pentanone (MIBK) Resource Conservation Recovery Program (NPW) 4-Methyl-2-pentanone (MIBK) Resource Conservation Recovery Program (S) Acetone Resource Conservation Recovery Program (NPW) Acetone Resource Conservation Recovery Program (S) Acetonitrile Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Acetonitrile Acrolein Resource Conservation Recovery Program (NPW) Acrolein Resource Conservation Recovery Program (S) Acrylonitrile Resource Conservation Recovery Program (NPW) Acrylonitrile Resource Conservation Recovery Program (S) Allyl chloride Resource Conservation Recovery Program (NPW) Aliyl chloride Resource Conservation Recovery Program (S) Benzene Resource Conservation Recovery Program (NPW) Benzene Resource Conservation Recovery Program (S) Bromobenzene Resource Conservation Recovery Program (NPW) Bromobenzene Resource Conservation Recovery Program (S) Bromochloromethane Resource Conservation Recovery Program (NPW) Bromochloromethane Resource Conservation Recovery Program (S) Bromodichloromethane Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Bromodichloromethane Bromoform Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Bromoform Bromomethane (Methyl bromide) Resource Conservation Recovery Program (NPW) Bromomethane (Methyl bromide) Resource Conservation Recovery Program (S) Carbon disulfide Resource Conservation Recovery Program (NPW) Carbon disulfide Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Carbon tetrachloride Carbon tetrachloride Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Chlorobenzene Chlorobenzene Resource Conservation Recovery Program (S) Chloroethane Resource Conservation Recovery Program (NPW) Chloroethane Resource Conservation Recovery Program (S) Chloroform Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Chloroform

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ME00019 Certificate Number: 2014018

FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016 Jennifer Jamison, Certification Officer

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Page 15 of 35

Chloroprene Resource Conservation Recovery Program (NPW) Chloroprene Resource Conservation Recovery Program (S) cis-1,2-Dichloroethylene Resource Conservation Recovery Program (NPW) cis-1,2-Dichloroethylene Resource Conservation Recovery Program (S) cis-1,3-Dichloropropene Resource Conservation Recovery Program (NPW) cis-1,3-Dichloropropene Resource Conservation Recovery Program (S) cis-1 4-Dichloro-2-butene Resource Conservation Recovery Program (NPW) cis-1,4-Dichloro-2-butene Resource Conservation Recovery Program (S) Cyclohexane Resource Conservation Recovery Program (NPW) Cyclohexane Resource Conservation Recovery Program (S) Dibromochloromethane Resource Conservation Recovery Program (NPW) Dibromochloromethane Resource Conservation Recovery Program (S) Dibromomethane Resource Conservation Recovery Program (NPW) Dibromomethane Resource Conservation Recovery Program (S) Dichlorodifluoromethane Resource Conservation Recovery Program (NPW) Dichlorodifluoromethane Resource Conservation Recovery Program (S) Dichloromethane (Methylene chloride) Resource Conservation Recovery Program (NPW) Dichloromethane (Methylene chloride) Resource Conservation Recovery Program (S) Diethyl ether Resource Conservation Recovery Program (NPW) Diethyl ether Resource Conservation Recovery Program (S) Diisopropylether (DIPE) Resource Conservation Recovery Program (NPW) Diisopropylether (DIPE) Resource Conservation Recovery Program (S) Ethyl methacrylate Resource Conservation Recovery Program (NPW) Ethyl methacrylate Resource Conservation Recovery Program (S) Ethylbenzene Resource Conservation Recovery Program (NPW) Ethylbenzene Resource Conservation Recovery Program (S) Ethyl-tert-butyl ether (ETBE) Resource Conservation Recovery Program (NPW) Ethyl-tert-butyl ether (ETBE) Resource Conservation Recovery Program (S) Freon-113 (Trichlorotrifluoroethane) Resource Conservation Recovery Program (NPW) Freon-113 (Trichlorotrifluoroethane) Resource Conservation Recovery Program (S) Hexachlorobutadiene Resource Conservation Recovery Program (NPW) Hexachlorobutadiene Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) lodomethane (Methyl iodide) lodomethane (Methyl iodide) Resource Conservation Recovery Program (S) Isobutyl alcohol Resource Conservation Recovery Program (NPW) Isobutyl alcohol Resource Conservation Recovery Program (S) Isopropylbenzene Resource Conservation Recovery Program (NPW) Isopropylbenzene Resource Conservation Recovery Program (S) Methacrylonitrile Resource Conservation Recovery Program (NPW) Methacrylonitrile Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Methyl acetate Methyl acetate Resource Conservation Recovery Program (S) Methyl chloride (Chloromethane) Resource Conservation Recovery Program (NPW) Methyl chloride (Chloromethane) Resource Conservation Recovery Program (S) Methyl isobutyl ketone (MIBK) Resource Conservation Recovery Program (NPW) Methyl isobutyl ketone (MIBK) Resource Conservation Recovery Program (S) Methyl methacrylate Resource Conservation Recovery Program (NPW) Methyl methacrylate Resource Conservation Recovery Program (S) Methyl tert-butyl ether (MTBE) Resource Conservation Recovery Program (NPW) Methyl tert-butyl ether (MTBE) Resource Conservation Recovery Program (S) Methylcyclohexane Resource Conservation Recovery Program (NPW) Methylcyclohexane Resource Conservation Recovery Program (S) m-Xylene Resource Conservation Recovery Program (NPW) m-Xylene Resource Conservation Recovery Program (S) Naphthalene Resource Conservation Recovery Program (NPW) Naphthalene Resource Conservation Recovery Program (S) n-Butylbenzene Resource Conservation Recovery Program (NPW) n-Butylbenzene Resource Conservation Recovery Program (S) n-Propylbenzene Resource Conservation Recovery Program (NPW) n-Propylbenzene Resource Conservation Recovery Program (S)

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Jennifer Jameson

Resource Conservation Recovery Program (NPW)

Page 16 of 35

o-Xylene	Resource Conservation Recovery Program (S)
Pentachloroethane	Resource Conservation Recovery Program (NPW)
Pentachloroethane	Resource Conservation Recovery Program (S)
p-Isopropyttoluene	Resource Conservation Recovery Program (NPW)
p-Isopropyltoluene	Resource Conservation Recovery Program (S)
Propionitrile (Ethyl cyanide)	Resource Conservation Recovery Program (NPW)
Propionitrile (Ethyl cyanide)	Resource Conservation Recovery Program (S)
p-Xylene	Resource Conservation Recovery Program (NPW)
p-Xylene	Resource Conservation Recovery Program (NPW)
p-Xylene	Resource Conservation Recovery Program (S)
sec-Butylbenzene	Resource Conservation Recovery Program (NPW)
sec-Butylbenzene	Resource Conservation Recovery Program (S)
Styrene	Resource Conservation Recovery Program (NPW)
Styrene	Resource Conservation Recovery Program (S)
tert-Amyl methyl ether (TAME)	Resource Conservation Recovery Program (NPW)
tert-Amyl methyl ether (TAME)	Resource Conservation Recovery Program (S)
tert-Butyl alcohol	Resource Conservation Recovery Program (NPW)
tert-Butyl alcohol	Resource Conservation Recovery Program (S)
tert-Butylbenzene	Resource Conservation Recovery Program (NPW)
tert-Butylbenzene	Resource Conservation Recovery Program (S)
Tetrachioroethylene	Resource Conservation Recovery Program (NPW)
Tetrachloroethylene	Resource Conservation Recovery Program (S)
Tetrahydrofuran (THF)	Resource Conservation Recovery Program (NPW)
Tetrahydrofuran (THF)	Resource Conservation Recovery Program (S)
Toluene	Resource Conservation Recovery Program (NPW)
Toluene	Resource Conservation Recovery Program (S)
trans-1,2-Dictoroethylene	Resource Conservation Recovery Program (NPW)
trans-1,2-Dictoroethylene trans-1,3-Dichloropropylene	Resource Conservation Recovery Program (S)
trans-1,3-Dichloropropylene	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
trans-1,4-Dichloro-2-butene	Resource Conservation Recovery Program (NPW)
trans-1,4-Dichtoro-2-butene	Resource Conservation Recovery Program (N)
Trichloroethene (Trichloroethylene)	Resource Conservation Recovery Program (NPW)
Trichloroethene (Trichloroethylene)	Resource Conservation Recovery Program (S)
Trichlorofluoromethane	Resource Conservation Recovery Program (NPW)
Trichlorofluoromethane	Resource Conservation Recovery Program (S)
Vinyl acetate	Resource Conservation Recovery Program (NPW)
Vinyl acetate	Resource Conservation Recovery Program (S)
Vinyl chloride	Resource Conservation Recovery Program (NPW)
Vinyl chloride	Resource Conservation Recovery Program (S)
Xylene (total)	Resource Conservation Recovery Program (NPW)
Xylene (total)	Resource Conservation Recovery Program (S)
EPA 8260C	
1,1,1,2-Tetrachioroethane	Resource Conservation Recovery Program (NPW)
1,1,1,2-Tetrachloroethane	Resource Conservation Recovery Program (S)
1,1,1-Trichloroethane	Resource Conservation Recovery Program (NPW)
1,1,1-Trichloroethane	Resource Conservation Recovery Program (S)
1,1,2,2-Tetrachloroethane	Resource Conservation Recovery Program (NPW)
1,1,2,2-Tetrachioroethane	Resource Conservation Recovery Program (S)
1,1,2-Trichloro-1,2,2-trifluoroethane	Resource Conservation Recovery Program (NPW)
1,1,2-Trichloro-1,2,2-trifluoroethane	Resource Conservation Recovery Program (S)
1,1,2-Trichloroethane	Resource Conservation Recovery Program (NPW)
1,1,2-Trichloroethane	Resource Conservation Recovery Program (S)
1,1-Dichloroethane	Resource Conservation Recovery Program (NPW)
1,1-Dichloroethane	Resource Conservation Recovery Program (S)
1,1-Dichloroethylene	Resource Conservation Recovery Program (NPW)
1,1-Dichloroethylene	Resource Conservation Recovery Program (S)
1,1-Dichloropropene	Resource Conservation Recovery Program (NPW)
1,1-Dichloropropene	Resource Conservation Recovery Program (S)
1,2,3-Trichlorobenzene	Resource Conservation Recovery Program (NPW)
1,2,3-Trichlorobenzene	Resource Conservation Recovery Program (S)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016 Jennyer Jameson

Jennifer Jamison, Certification Officer

Page 17 of 35

1,2,3-Trichloropropane Resource Conservation Recovery Program (NPW) 1.2.3-Trichloropropane Resource Conservation Recovery Program (S) 1,2,4-Trichlorobenzene Resource Conservation Recovery Program (NPW) 1,2,4-Trichlorobenzene Resource Conservation Recovery Program (S) 1,2,4-Trimethylbenzene Resource Conservation Recovery Program (NPW) 1,2,4-Trimethylbenzene Resource Conservation Recovery Program (S) 1,2-Dibromo-3-chloropropane (DBCP) Resource Conservation Recovery Program (NPW) 1,2-Dibromo-3-chloropropane (DBCP) Resource Conservation Recovery Program (S) 1,2-Dibromoethane (EDB, Ethylene dibromide) Resource Conservation Recovery Program (NPW) 1,2-Dibromoethane (EDB, Ethylene dibromide) Resource Conservation Recovery Program (S) 1,2-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.2-Dichloroberszene Resource Conservation Recovery Program (S) 1.2-Dichloroethane Resource Conservation Recovery Program (NPW) 1.2-Dichlomethane Resource Conservation Recovery Program (S) 1,2-Dichloropropane Resource Conservation Recovery Program (NPW) 1.2-Dichloropropane Resource Conservation Recovery Program (S) 1,3,5-Trichlorobenzene Resource Conservation Recovery Program (NPW) 1,3,5-Trichlorobenzene Resource Conservation Recovery Program (S) 1,3,5-Trimethylbenzene Resource Conservation Recovery Program (NPW) 1,3,5-Trimethylbenzene Resource Conservation Recovery Program (S) 1.3-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.3-Dichlorobenzene Resource Conservation Recovery Program (S) 1.3-Dichloropropane Resource Conservation Recovery Program (NPW) 1,3-Dichloropropane Resource Conservation Recovery Program (S) 1.4-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.4-Dichlorobenzene Resource Conservation Recovery Program (S) 1,4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (NPW) 1,4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (S) 1-Chlorohexane Resource Conservation Recovery Program (NPW) 1-Chlorohexane Resource Conservation Recovery Program (S) 2,2-Dichloropropane Resource Conservation Recovery Program (NPW) 2,2-Dichloropropane Resource Conservation Recovery Program (S) 2-Butanone (Methyl ethyl ketone, MEK) Resource Conservation Recovery Program (NPW) 2-Butanone (Methyl ethyl ketone, MEK) Resource Conservation Recovery Program (S) 2-Chloroethyl vinyl ether Resource Conservation Recovery Program (NPW) 2-Chloroethyl vinyl ether Resource Conservation Recovery Program (S) 2-Chlorotoluene Resource Conservation Recovery Program (NPW) 2-Chlorotoluene Resource Conservation Recovery Program (S) 2-Hexanone Resource Conservation Recovery Program (NPW) 2-Hexanone Resource Conservation Recovery Program (S) 4-Chlorotoluene Resource Conservation Recovery Program (NPW) 4-Chlorotoluene Resource Conservation Recovery Program (S) 4-Methyl-2-pentanone (MIBK) Resource Conservation Recovery Program (NPW) 4-Methyl-2-pentanone (MIBK) Resource Conservation Recovery Program (S) Acetone Resource Conservation Recovery Program (NPW) Acetone Resource Conservation Recovery Program (S) Acetonitrile Resource Conservation Recovery Program (NPW) Acetonitrile Resource Conservation Recovery Program (S) Acrolein Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Acrolein Acrylonitrile Resource Conservation Recovery Program (NPW) Acrylonitrile Resource Conservation Recovery Program (S) Allyl chloride Resource Conservation Recovery Program (NPW) Allyl chloride Resource Conservation Recovery Program (S) Benzene Resource Conservation Recovery Program (NPW) Benzene Resource Conservation Recovery Program (S) Bromobenzene Resource Conservation Recovery Program (NPW) Bromobenzene Resource Conservation Recovery Program (S) Bromochloromethane Resource Conservation Recovery Program (NPW) Bromochloromethane Resource Conservation Recovery Program (S)

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Bromodichloromethane

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Resource Conservation Recovery Program (NPW)

Page 18 of 35

Bromodichloromethane Resource Conservation Recovery Program (S) Bromoform Resource Conservation Recovery Program (NPW) Bromoform Resource Conservation Recovery Program (S) Bromomethane (Methyl bromide) Resource Conservation Recovery Program (NPW) Bromomethane (Methyl bromide) Resource Conservation Recovery Program (S) Carbon disulfide Resource Conservation Recovery Program (NPW) Carbon disulfide Resource Conservation Recovery Program (S) Carbon tetrachloride Resource Conservation Recovery Program (NPW) Carbon tetrachloride Resource Conservation Recovery Program (S) Chlorobenzene Resource Conservation Recovery Program (NPW) Chlorobenzene Resource Conservation Recovery Program (S) Chloroethage Resource Conservation Recovery Program (NPW) Chloroethane Resource Conservation Recovery Program (S) Chloroform Resource Conservation Recovery Program (NPW) Chloroform Resource Conservation Recovery Program (S) Chloroprene Resource Conservation Recovery Program (NPW) Chloroprene Resource Conservation Recovery Program (S) cis-1,2-Dichloroethylene Resource Conservation Recovery Program (NPW) cis-1,2-Dichloroethylene Resource Conservation Recovery Program (S) cis-1,3-Dichloropropene Resource Conservation Recovery Program (NPW) cis-1,3-Dichloropropene Resource Conservation Recovery Program (S) cis-1,4-Dichloro-2-butene Resource Conservation Recovery Program (NPW) cis-1,4-Dichloro-2-butene Resource Conservation Recovery Program (S) Cyclohexane Resource Conservation Recovery Program (NPW) Cyclohexane Resource Conservation Recovery Program (S) Dibromochloromethane Resource Conservation Recovery Program (NPW) Dibromochloromethane Resource Conservation Recovery Program (S) Dibromomethane Resource Conservation Recovery Program (NPW) Dibromomethane Resource Conservation Recovery Program (S) Dichlorodifluoromethane Resource Conservation Recovery Program (NPW) Dichlorodifluoromethane Resource Conservation Recovery Program (S) Dichloromethane (Methylene chloride) Resource Conservation Recovery Program (NPW) Dichloromethane (Methylene chloride) Resource Conservation Recovery Program (S) Diethyl ether Resource Conservation Recovery Program (NPW) Diethyl ether Resource Conservation Recovery Program (S) Diisopropylether (DIPE) Resource Conservation Recovery Program (NPW) Diisopropylether (DIPE) Resource Conservation Recovery Program (S) Ethyl methacrylate Resource Conservation Recovery Program (NPW) Ethyl methacrylate Resource Conservation Recovery Program (S) Ethylbenzene Resource Conservation Recovery Program (NPW) Ethylbenzene Resource Conservation Recovery Program (S) Ethyl-tert-butyl ether (ETBE) Resource Conservation Recovery Program (NPW) Ethyl-tert-butyl ether (ETBE) Resource Conservation Recovery Program (S) Freon-113 (Trichlorotrifluoroethane) Resource Conservation Recovery Program (NPW) Freon-113 (Trichlorotrifluoroethane) Resource Conservation Recovery Program (S) Hexachlorobutadiene Resource Conservation Recovery Program (NPW) Hexachlorobutadiene Resource Conservation Recovery Program (S) lodomethane (Methyl iodide) Resource Conservation Recovery Program (NPW) lodomethane (Methyl iodide) Resource Conservation Recovery Program (S) isobutyl alcohol Resource Conservation Recovery Program (NPW) isobutyl alcohol Resource Conservation Recovery Program (S) isopropylbenzene Resource Conservation Recovery Program (NPW) isopropyibenzene Resource Conservation Recovery Program (S) Methacrylonitrile Resource Conservation Recovery Program (NPW) Methacrylonitrile Resource Conservation Recovery Program (S) Methyl acetate Resource Conservation Recovery Program (NPW) Methyl acetate Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Methyl chloride (Chloromethane) Methyl chloride (Chloromethane) Resource Conservation Recovery Program (S)

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Methyl isobutyl ketone (MIBK)

Methyl isobutyl ketone (MIBK)

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Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Page 19 of 35

Methyl methacrylate Resource Conservation Recovery Program (NPW) Methyl methacrylate Resource Conservation Recovery Program (S) Methyl tert-butyl ether (MTBE) Resource Conservation Recovery Program (NPW) Methyl tert-butyl ether (MTBE) Resource Conservation Recovery Program (S) Methylcyclohexane Resource Conservation Recovery Program (NPW) Methylcyclohexane Resource Conservation Recovery Program (S) m-Xylene Resource Conservation Recovery Program (NPW) m-Xylene Resource Conservation Recovery Program (S) Naphthalene Resource Conservation Recovery Program (NPW) Naphthalene Resource Conservation Recovery Program (S) n-Butvlbenzene Resource Conservation Recovery Program (NPW) n-Butylbenzene Resource Conservation Recovery Program (S) n-Propylbenzene Resource Conservation Recovery Program (NPW) n-Propylbenzene Resource Conservation Recovery Program (S) Pentachloroethane Resource Conservation Recovery Program (NPW) Pentachloroethane Resource Conservation Recovery Program (S) p-Isopropyltoluene Resource Conservation Recovery Program (NPW) p-isopropyltoluene Resource Conservation Recovery Program (S) Propionitrile (Ethyl cyanide) Resource Conservation Recovery Program (NPW) Propionitrile (Ethyl cyanide) Resource Conservation Recovery Program (S) p-Xylene Resource Conservation Recovery Program (NPW) p-Xylene Resource Conservation Recovery Program (S) sec-Butylbenzene Resource Conservation Recovery Program (NPW) sec-Butylbenzene Resource Conservation Recovery Program (S) Styrene Resource Conservation Recovery Program (NPW) Styrene Resource Conservation Recovery Program (S) tert-Amyl methyl ether (TAME) Resource Conservation Recovery Program (NPW) tert-Amyl methyl ether (TAME) Resource Conservation Recovery Program (S) tert-Butyl alcohol Resource Conservation Recovery Program (NPW) tert-Butyl alcohol Resource Conservation Recovery Program (S) tert-Butylbenzene Resource Conservation Recovery Program (NPW) tert-Butvibenzene Resource Conservation Recovery Program (S) Tetrachloroethylene Resource Conservation Recovery Program (NPW) Tetrachloroethylene Resource Conservation Recovery Program (S) Tetrahydrofuran (THF) Resource Conservation Recovery Program (NPW) Tetrahydrofuran (THF) Resource Conservation Recovery Program (\$) Toluene Resource Conservation Recovery Program (NPW) Toluene Resource Conservation Recovery Program (S) trans-1,2-Dicloroethylene Resource Conservation Recovery Program (NPW) trans-1,2-Dicloroethylene Resource Conservation Recovery Program (S) trans-1,3-Dichloropropylene Resource Conservation Recovery Program (NPW) trans-1,3-Dichloropropylene Resource Conservation Recovery Program (S) trans-1 4-Dichloro-2-butene Resource Conservation Recovery Program (NPW) trans-1,4-Dichloro-2-butene Resource Conservation Recovery Program (S) Trichloroethene (Trichloroethylene) Resource Conservation Recovery Program (NPW) Trichloroethene (Trichloroethylene) Resource Conservation Recovery Program (S) Trichlorofluoromethane Resource Conservation Recovery Program (NPW) Trichlorofluoromethane Resource Conservation Recovery Program (S) Vinvl acetate Resource Conservation Recovery Program (NPW) Vinvi acetate Resource Conservation Recovery Program (S) Vinyl chloride Resource Conservation Recovery Program (NPW) Vinyl chloride Resource Conservation Recovery Program (S) Xylene (total) Resource Conservation Recovery Program (NPW) Xylene (total) Resource Conservation Recovery Program (S) **EPA 8270C** 1,1 -Biphenyl Resource Conservation Recovery Program (NPW) 1,1 -Biphenyl Resource Conservation Recovery Program (S) 1,2,4,5-Tetrachlorobenzene Resource Conservation Recovery Program (NPW) 1,2,4,5-Tetrachlorobenzene Resource Conservation Recovery Program (S) 1.2.4-Trichlorobenzene Resource Conservation Recovery Program (NPW) 1.2.4-Trichlorobenzene Resource Conservation Recovery Program (S)

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ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 20 of 35

1.2-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1,2-Dichlorobenzene Resource Conservation Recovery Program (S) 1,2-Diphenylhydrazine Resource Conservation Recovery Program (NPW) 1,2-Diphenylhydrazine Resource Conservation Recovery Program (S) 1,3,5-Trinitrobenzene (1,3,5-TNB) Resource Conservation Recovery Program (NPW) 1,3,5-Trinitrobenzene (1,3,5-TNB) Resource Conservation Recovery Program (S) 1,3-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.3-Dichlorobenzene Resource Conservation Recovery Program (S) 1.3-Dinitrobenzene (1.3-DNB) Resource Conservation Recovery Program (NPW) 1,3-Dinitrobenzene (1,3-DNB) Resource Conservation Recovery Program (S) 1,4-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.4-Dichlorobenzene Resource Conservation Recovery Program (S) 1,4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (NPW) 1,4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (S) 1,4-Naphthoquinone Resource Conservation Recovery Program (NPW) 1,4-Naphthoguinone Resource Conservation Recovery Program (S) 1-Chloropaphthalene Resource Conservation Recovery Program (NPW) 1-Chloronaphthalene Resource Conservation Recovery Program (S) 1-Methylnaphthalene Resource Conservation Recovery Program (NPW) 1-Methylnaphthalene Resource Conservation Recovery Program (S) 1-Naphthylamine Resource Conservation Recovery Program (NPW) 1-Naphthylamine Resource Conservation Recovery Program (S) 2,2'-Oxybis(1-chloropropane) Resource Conservation Recovery Program (NPW) 2.2'-Oxybis(1-chloropropane) Resource Conservation Recovery Program (S) 2,3,4,6-Tetrachlorophenol Resource Conservation Recovery Program (NPW) 2.3.4.6-Tetrachlorophenol Resource Conservation Recovery Program (S) 2,4,5-Trichlorophenol Resource Conservation Recovery Program (NPW) 2,4,5-Trichlorophenol Resource Conservation Recovery Program (S) 2.4.6-Trichlorophenol Resource Conservation Recovery Program (NPW) 2,4,6-Trichlorophenol Resource Conservation Recovery Program (S) 2.4-Dichlorophenol Resource Conservation Recovery Program (NPW) 2,4-Dichlorophenol Resource Conservation Recovery Program (S) 2,4-Dimethylphenol Resource Conservation Recovery Program (NPW) 2,4-Dimethylphenol Resource Conservation Recovery Program (S) 2,4-Dinitrophenol Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) 2,4-Dinitrophenol 2,4-Dinitrotoluene (2,4-DNT) Resource Conservation Recovery Program (NPW) 2.4-Dinitrotoluene (2.4-DNT) Resource Conservation Recovery Program (S) 2,6-Dichlorophenol Resource Conservation Recovery Program (NPW) 2.6-Dichlorophenol Resource Conservation Recovery Program (S) 2,6-Dinitrotoluene (2,6-DNT) Resource Conservation Recovery Program (NPW) 2,6-Dinitrotoluene (2,6-DNT) Resource Conservation Recovery Program (S) 2-Acetylaminofluorene Resource Conservation Recovery Program (NPW) 2-Acetylaminofluorene Resource Conservation Recovery Program (S) 2-Chloronaphthalene Resource Conservation Recovery Program (NPW) 2-Chioronaphthalene Resource Conservation Recovery Program (S) 2-Chiorophenol Resource Conservation Recovery Program (NPW) 2-Chlorophenol Resource Conservation Recovery Program (S) 2-Methylnaphthalene Resource Conservation Recovery Program (NPW) 2-Methylnaphthalene Resource Conservation Recovery Program (S) 2-Methylphenol (o-Cresol) Resource Conservation Recovery Program (NPW) 2-Methylphenol (o-Cresol) Resource Conservation Recovery Program (S) 2-Naphthylamine Resource Conservation Recovery Program (NPW) 2-Naphthylamine Resource Conservation Recovery Program (S) 2-Nitroaniline Resource Conservation Recovery Program (NPW) 2-Nitroaniline Resource Conservation Recovery Program (S) 2-Nitropheno Resource Conservation Recovery Program (NPW) 2-Nitrophenol Resource Conservation Recovery Program (S) 2-Picoline (2-Methylpyridine) Resource Conservation Recovery Program (NPW) 2-Picoline (2-Methylpyridine) Resource Conservation Recovery Program (S) 3 & 4 Methylphenol Resource Conservation Recovery Program (NPW)

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ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Jennifer Jameson

Page 21 of 35

3 & 4 Methylphenol Resource Conservation Recovery Program (S) 3,3'-Dichlorobenzidine Resource Conservation Recovery Program (NPW) 3.3'-Dichlorobenzidine Resource Conservation Recovery Program (S) 3.3'-Dimethylbenzidine Resource Conservation Recovery Program (NPW) 3 3'-Dimethylbenzidine Resource Conservation Recovery Program (S) 3-Methylcholanthrene Resource Conservation Recovery Program (NPW) 3-Methylcholanthrene Resource Conservation Recovery Program (S) 3-Nitroaniline Resource Conservation Recovery Program (NPW) 3-Nitroaniline Resource Conservation Recovery Program (S) 4,6-Dinitro-2-methylphenol Resource Conservation Recovery Program (NPW) 4,6-Dinitro-2-methylphenol Resource Conservation Recovery Program (S) 4-Aminobiohenvl Resource Conservation Recovery Program (NPW) 4-Aminobiphenyl Resource Conservation Recovery Program (S) 4-Bromophenyl phenyl ether Resource Conservation Recovery Program (NPW) 4-Bromophenyl phenyl ether Resource Conservation Recovery Program (S) 4-Chloro-3-methylphenol Resource Conservation Recovery Program (NPW) 4-Chloro-3-methylphenol Resource Conservation Recovery Program (S) 4-Chloroaniline Resource Conservation Recovery Program (NPW) 4-Chloroaniline Resource Conservation Recovery Program (S) 4-Chlorophenyl phenylether Resource Conservation Recovery Program (NPW) 4-Chlorophenyl phenylether Resource Conservation Recovery Program (S) 4-Nitroaniline Resource Conservation Recovery Program (NPW) 4-Nitroaniline Resource Conservation Recovery Program (S) 4-Nitrophenol Resource Conservation Recovery Program (NPW) 4-Nitrophenol Resource Conservation Recovery Program (S) 4-Nitroquinoline 1-oxide Resource Conservation Recovery Program (NPW) 4-Nitroquinoline 1-oxide Resource Conservation Recovery Program (S) 5-Nitro-o-toluidine Resource Conservation Recovery Program (NPW) 5-Nitro-o-toluidine Resource Conservation Recovery Program (S) 7,12-Dimethylbenz[a]anthracene Resource Conservation Recovery Program (NPW) 7,12-Dimethylbenz[a]anthracene Resource Conservation Recovery Program (S) a-a-Dimethylphenethylamine Resource Conservation Recovery Program (NPW) a-a-Dimethylphenethylamine Resource Conservation Recovery Program (S) Acenaphthene Resource Conservation Recovery Program (NPW) Acenaphthene Resource Conservation Recovery Program (S) Acenaphthylene Resource Conservation Recovery Program (NPW) Acenaphthylene Resource Conservation Recovery Program (S) Acetophenone Resource Conservation Recovery Program (NPW) Acetophenone Resource Conservation Recovery Program (S) Aniline Resource Conservation Recovery Program (NPW) Aniline Resource Conservation Recovery Program (S) Anthracene Resource Conservation Recovery Program (NPW) Anthracene Resource Conservation Recovery Program (S) Aramite Resource Conservation Recovery Program (NPW) Aramite Resource Conservation Recovery Program (S) Atrazine Resource Conservation Recovery Program (NPW) Atrazine Resource Conservation Recovery Program (S) Azobenzene Resource Conservation Recovery Program (NPW) Azobenzene Resource Conservation Recovery Program (S) Benzaldehyde Resource Conservation Recovery Program (NPW) Benzaldehyde Resource Conservation Recovery Program (S) Benzidine Resource Conservation Recovery Program (NPW) Benzidine Resource Conservation Recovery Program (S) Benzo[a]anthracene Resource Conservation Recovery Program (NPW) Benzolalanthracene Resource Conservation Recovery Program (S) Benzo[a]pyrene Resource Conservation Recovery Program (NPW) Benzo[a]pyrene Resource Conservation Recovery Program (S) Benzo[b]fluoranthene Resource Conservation Recovery Program (NPW) Benzo[b]fluoranthene Resource Conservation Recovery Program (S)

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Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Benzo[g,h,i]perylene

Benzola, h. ilpervlene

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Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Page 22 of 35

Benzolkifluoranthene Resource Conservation Recovery Program (NPW) Benzo(k)fluoranthene Resource Conservation Recovery Program (S) Benzoic acid Resource Conservation Recovery Program (NPW) Benzoic acid Resource Conservation Recovery Program (S) Benzyl alcohol Resource Conservation Recovery Program (NPW) Benzyl alcohol Resource Conservation Recovery Program (S) bis(2-Chloroethoxy)methane Resource Conservation Recovery Program (NPW) bis(2-Chloroethoxy)methane Resource Conservation Recovery Program (S) bis(2-Chloroethyl)ether Resource Conservation Recovery Program (NPW) bis(2-Chloroethyl)ether Resource Conservation Recovery Program (S) bis(2-Ethylhexyl)adipate Resource Conservation Recovery Program (NPW) bis(2-Ethvlhexvl)adipate Resource Conservation Recovery Program (S) bis(2-Ethylhexyl)phthalate (DEHP) Resource Conservation Recovery Program (NPW) bis(2-Ethylhexyl)phthalate (DEHP) Resource Conservation Recovery Program (S) Butyl benzyl phthalate Resource Conservation Recovery Program (NPW) Butyl benzyl phthalate Resource Conservation Recovery Program (S) Caprolactam Resource Conservation Recovery Program (NPW) Caprolactam Resource Conservation Recovery Program (S) Carbazole Resource Conservation Recovery Program (NPW) Carbazole Resource Conservation Recovery Program (S) Chlorobenzilate Resource Conservation Recovery Program (NPW) Chlorobenzilate Resource Conservation Recovery Program (S) Chrysene Resource Conservation Recovery Program (NPW) Chrysene Resource Conservation Recovery Program (S) Diallate Resource Conservation Recovery Program (NPW) Diallate Resource Conservation Recovery Program (S) Dibenz[a,h]anthracene Resource Conservation Recovery Program (NPW) Dibenz[a,h]anthracene Resource Conservation Recovery Program (S) Dibenz[a,j]acridine Resource Conservation Recovery Program (NPW) Dibenz[a,j]acridine Resource Conservation Recovery Program (S) Dibenzofuran Resource Conservation Recovery Program (NPW) Dibenzofuran Resource Conservation Recovery Program (S) Diethyl phthalate Resource Conservation Recovery Program (NPW) Diethyl phthalate Resource Conservation Recovery Program (S) Dimethoate Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Dimethoate Dimethyl phthalate Resource Conservation Recovery Program (NPW) Dimethyl phthalate Resource Conservation Recovery Program (S) Di-n-butyl phthalate Resource Conservation Recovery Program (NPW) Di-n-butyl phthalate Resource Conservation Recovery Program (S) Di-n-octyl phthalate Resource Conservation Recovery Program (NPW) Di-n-octyl phthalate Resource Conservation Recovery Program (S) Dinoseb Resource Conservation Recovery Program (NPW) Dinoseb Resource Conservation Recovery Program (S) Disulfoton Resource Conservation Recovery Program (NPW) Disulfoton Resource Conservation Recovery Program (S) Ethyl methanesulfonate Resource Conservation Recovery Program (NPW) Ethyl methanesulfonate Resource Conservation Recovery Program (S) Famphur Resource Conservation Recovery Program (NPW) Famphur Resource Conservation Recovery Program (S)

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Fluoranthene

Fluoranthene

Hexachlorobenzene

Hexachlorobenzene

Hexachlorobutadiene

Hexachlorobutadiene

Hexachloroethane

Hexachlorocyclopentadiene

Hexachlorocyclopentadiene

Fluorene

Fluorene

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Page 23 of 35

Hexachloroethane Resource Conservation Recovery Program (S) Hexachlorophene Resource Conservation Recovery Program (NPW) Hexachlorophene Resource Conservation Recovery Program (S) Hexachloropropene Resource Conservation Recovery Program (NPW) Hexachloropropene Resource Conservation Recovery Program (S) Indeno[1,2,3-cd]pyrene Resource Conservation Recovery Program (NPW) Indeno[1,2,3-cd]pyrene Resource Conservation Recovery Program (S) isodrin Resource Conservation Recovery Program (NPW) Isodrin Resource Conservation Recovery Program (S) Isophorone Resource Conservation Recovery Program (NPW) Isophorone Resource Conservation Recovery Program (S) Isosafroie Resource Conservation Recovery Program (NPW) isosafrole Resource Conservation Recovery Program (S) Kepone Resource Conservation Recovery Program (NPW) Kepone Resource Conservation Recovery Program (S) Methapyrilene Resource Conservation Recovery Program (NPW) Methapyrilene Resource Conservation Recovery Program (S) Methyl methanesulfonate Resource Conservation Recovery Program (NPW) Methyl methanesulfonate Resource Conservation Recovery Program (S) Methyl parathion Resource Conservation Recovery Program (NPW) Methyl parathion Resource Conservation Recovery Program (S) Naphthalene Resource Conservation Recovery Program (NPW) Naphthalene Resource Conservation Recovery Program (S) Nitrobenzene Resource Conservation Recovery Program (NPW) Nitrobenzene Resource Conservation Recovery Program (S) n-Nitrosodiethylamine Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) n-Nitrosodiethylamine n-Nitrosodimethylamine Resource Conservation Recovery Program (NPW) n-Nitrosodimethylamine Resource Conservation Recovery Program (S) n-Nitroso-di-n-butylamine Resource Conservation Recovery Program (NPW) n-Nitroso-di-n-butylamine Resource Conservation Recovery Program (S) n-Nitroso-di-n-propylamine Resource Conservation Recovery Program (NPW) n-Nitroso-di-n-propylamine Resource Conservation Recovery Program (S) n-Nitrosodiphenylamine Resource Conservation Recovery Program (NPW) n-Nitrosodiphenylamine Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) n-Nitrosomethylethylamine n-Nitrosomethylethylamine Resource Conservation Recovery Program (S) n-Nitrosomorpholine Resource Conservation Recovery Program (NPW) n-Nitrosomorpholine Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) n-Nitrosopiperidine n-Nitrosopiperidine Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) n-Nitrosopyrrolidine n-Nitrosopyrrolidine Resource Conservation Recovery Program (S) o,o,o-Triethyl phosphorothioate Resource Conservation Recovery Program (NPW) o,o,o-Triethyl phosphorothioate Resource Conservation Recovery Program (S) o-Toluidine Resource Conservation Recovery Program (NPW) o-Toluidine Resource Conservation Recovery Program (S) Parathion Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Pentachiorobeozene Resource Conservation Recovery Program (NPW) Pentachiorobenzene Resource Conservation Recovery Program (S) Pentachloronitrobenzene Resource Conservation Recovery Program (NPW) Pentachloronitrobenzene Resource Conservation Recovery Program (S) Pentachiorophenol Resource Conservation Recovery Program (NPW) Pentachlorophenol Resource Conservation Recovery Program (S) Phenacetin Resource Conservation Recovery Program (NPW) Phenacetin Resource Conservation Recovery Program (S) Phenanthrene Resource Conservation Recovery Program (NPW) Phenanthrene Resource Conservation Recovery Program (S)

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ME00019
Certificate Number:

Phenol

FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

2014018

Jennifer Jamison, Certification Officer

Page 24 of 35

Resource Conservation Recovery Program (NPW)
Resource Conservation Recovery Program (S)

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Phorate Resource Conservation Recovery Program (NPW) Phorate Resource Conservation Recovery Program (S) p-Phenylenediamine Resource Conservation Recovery Program (NPW) p-Phenylenediamine Resource Conservation Recovery Program (S) Pronamide (Kerb) Resource Conservation Recovery Program (NPW) Pronamide (Kerb) Resource Conservation Recovery Program (S) Pyrene Resource Conservation Recovery Program (NPW) Pyrene Resource Conservation Recovery Program (S) Pyridine Resource Conservation Recovery Program (NPW) Pyridine Resource Conservation Recovery Program (S) Safrole Resource Conservation Recovery Program (NPW) Safrole Resource Conservation Recovery Program (S) Sulfotepp Resource Conservation Recovery Program (NPW) Sulfoteop Resource Conservation Recovery Program (S) **EPA 8270D** 1,1'-Biphenyl Resource Conservation Recovery Program (NPW) 1.1'-Biphenyl Resource Conservation Recovery Program (S) 1,2,4,5-Tetrachlorobenzene Resource Conservation Recovery Program (NPW) 1,2,4,5-Tetrachlorobenzene Resource Conservation Recovery Program (S) 1.2.4-Trichlorobenzene Resource Conservation Recovery Program (NPW) 1,2,4-Trichlorobenzene Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) 1.2-Dichlorobenzene 1.2-Dichlorobenzene Resource Conservation Recovery Program (S) 1.2-Diphenylhydrazine Resource Conservation Recovery Program (NPW) 1,2-Diphenylhydrazine Resource Conservation Recovery Program (S) 1.3.5-Trinitrobenzene (1.3.5-TNB) Resource Conservation Recovery Program (NPW) 1,3,5-Trinitrobenzene (1,3,5-TNB) Resource Conservation Recovery Program (S) 1,3-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.3-Dichlorobenzene Resource Conservation Recovery Program (S) 1,3-Dinitrobenzene (1,3-DNB) Resource Conservation Recovery Program (NPW) 1,3-Dinitrobenzene (1,3-DNB) Resource Conservation Recovery Program (S) 1.4-Dichlorobenzene Resource Conservation Recovery Program (NPW) 1.4-Dichlorobenzene Resource Conservation Recovery Program (S) 1,4-Dioxane (1,4-Diethyleneoxide) Resource Conservation Recovery Program (NPW) 1.4-Dioxane (1,4- Diethyleneoxide) Resource Conservation Recovery Program (S) 1,4-Naphthoquinone Resource Conservation Recovery Program (NPW) 1.4-Naphthoguinone Resource Conservation Recovery Program (S) 1-Chloronaphthalene Resource Conservation Recovery Program (NPW) 1-Chloronaphthalene Resource Conservation Recovery Program (S) 1-Methylnaphthalene Resource Conservation Recovery Program (NPW) 1-Methylnaphthalene Resource Conservation Recovery Program (S) 1-Naphthylamine Resource Conservation Recovery Program (NPW) 1-Naphthylamine Resource Conservation Recovery Program (S) 2,2'-Oxybis(1-chloropropane) Resource Conservation Recovery Program (NPW) 2,2'-Oxybis(1-chloropropane) Resource Conservation Recovery Program (S) 2,3,4,6-Tetrachiorophenol Resource Conservation Recovery Program (NPW) 2,3,4,6-Tetrachlorophenol Resource Conservation Recovery Program (S) 2,4,5-Trichlorophenol Resource Conservation Recovery Program (NPW) 2,4,5-Trichlorophenol Resource Conservation Recovery Program (S) 2.4.6-Trichlorophenol Resource Conservation Recovery Program (NPW) 2,4,6-Trichlorophenol Resource Conservation Recovery Program (S) 2.4-Dichlorophenol Resource Conservation Recovery Program (NPW) 2,4-Dichlorophenol Resource Conservation Recovery Program (S) 2.4-Dimethylphenol Resource Conservation Recovery Program (NPW) 2,4-Dimethylphenol Resource Conservation Recovery Program (S) 2.4-Dinitrophenol Resource Conservation Recovery Program (NPW) 2,4-Dinitrophenol Resource Conservation Recovery Program (S) 2,4-Dinitrotoluene (2,4-DNT) Resource Conservation Recovery Program (NPW) 2,4-Dinitrotoluene (2,4-DNT) Resource Conservation Recovery Program (S) 2.6-Dichloropheno Resource Conservation Recovery Program (NPW) 2,6-Dichlorophenol Resource Conservation Recovery Program (S)

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ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Jennifer Jameson

Page 25 of 35

2.6-Dinitrotoluene (2.6-DNT) Resource Conservation Recovery Program (NPW) 2,6-Dinitrotoluene (2,6-DNT) Resource Conservation Recovery Program (S) 2-Acetylaminofluorene Resource Conservation Recovery Program (NPW) 2-Acetylaminofluorene Resource Conservation Recovery Program (S) 2-Chloronaphthalene Resource Conservation Recovery Program (NPW) 2-Chloronaphthalene Resource Conservation Recovery Program (S) 2-Chlorophenol Resource Conservation Recovery Program (NPW) 2-Chiorophenol Resource Conservation Recovery Program (S) 2-Methylnaphthalene Resource Conservation Recovery Program (NPW) 2-Methylnaphthalene Resource Conservation Recovery Program (S) 2-Methylphenol (o-Cresol) Resource Conservation Recovery Program (NPW) 2-Methylphenol (o-Cresol) Resource Conservation Recovery Program (S) 2-Naphthylamine Resource Conservation Recovery Program (NPW) 2-Naphthylamine Resource Conservation Recovery Program (S) 2-Nitroaniline Resource Conservation Recovery Program (NPW) 2-Nitroaniline Resource Conservation Recovery Program (S) 2-Nitrophenol Resource Conservation Recovery Program (NPW) 2-Nitrophenol Resource Conservation Recovery Program (S) 2-Picoline (2-Methylpyridine) Resource Conservation Recovery Program (NPW) 2-Picoline (2-Methylpyridine) Resource Conservation Recovery Program (S) 3 & 4 Methylphenoi Resource Conservation Recovery Program (NPW) 3 & 4 Methylphenol Resource Conservation Recovery Program (S) 3,3'-Dichlorobenzidine Resource Conservation Recovery Program (NPW) 3,3'-Dichlorobenzidine Resource Conservation Recovery Program (S) 3.3'-Dimethylbenzidine Resource Conservation Recovery Program (NPW) 3,3'-Dimethylbenzidine Resource Conservation Recovery Program (S) 3-Methylcholanthrene Resource Conservation Recovery Program (NPW) 3-Methylcholanthrene Resource Conservation Recovery Program (S) 3-Nitroaniline Resource Conservation Recovery Program (NPW) 3-Nitroaniline Resource Conservation Recovery Program (S) 4,6-Dinitro-2-methylphenol Resource Conservation Recovery Program (NPW) 4,6-Dinitro-2-methylphenol Resource Conservation Recovery Program (S) 4-Aminobiphenyl Resource Conservation Recovery Program (NPW) 4-Aminobiphenyl Resource Conservation Recovery Program (S) 4-Bromophenyl phenyl ether Resource Conservation Recovery Program (NPW) 4-Bromophenyl phenyl ether Resource Conservation Recovery Program (S) 4-Chloro-3-methylphenol Resource Conservation Recovery Program (NPW) 4-Chloro-3-methylphenol Resource Conservation Recovery Program (S) 4-Chloroaniline Resource Conservation Recovery Program (NPW) 4-Chloroaniline Resource Conservation Recovery Program (S) 4-Chlorophenyl phenylether Resource Conservation Recovery Program (NPW) 4-Chlorophenyl phenylether Resource Conservation Recovery Program (S) 4-Nitroaniline Resource Conservation Recovery Program (NPW) 4-Nitroaniline Resource Conservation Recovery Program (S) 4-Nitrophenol Resource Conservation Recovery Program (NPW) 4-Nitrophenol Resource Conservation Recovery Program (S) 4-Nitroquinoline 1-oxide Resource Conservation Recovery Program (NPW) 4-Nitroquinoline 1-oxide Resource Conservation Recovery Program (S) 5-Nitro-o-toluidine Resource Conservation Recovery Program (NPW) 5-Nitro-o-toluidine Resource Conservation Recovery Program (S) 7,12-Dimethylbenz[a]anthracene Resource Conservation Recovery Program (NPW) 7,12-Dimethylbenz(a)anthracene Resource Conservation Recovery Program (S) a-a-Dimethylphenethylamine Resource Conservation Recovery Program (NPW) a-a-Dimethylphenethylamine Resource Conservation Recovery Program (S) Acenaphthene Resource Conservation Recovery Program (NPW) Acenaphthene Resource Conservation Recovery Program (S) Acenaphthylene Resource Conservation Recovery Program (NPW) Acenaphthylene Resource Conservation Recovery Program (S) Acetophenone Resource Conservation Recovery Program (NPW) Acetophenone Resource Conservation Recovery Program (S)

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Resource Conservation Recovery Program (NPW)

Page 26 of 35

Aniline Resource Conservation Recovery Program (S) Anthracene Resource Conservation Recovery Program (NPW) Anthracene Resource Conservation Recovery Program (S) Aramite Resource Conservation Recovery Program (NPW) Aramite Resource Conservation Recovery Program (S) Atrazine Resource Conservation Recovery Program (NPW) Atrazine Resource Conservation Recovery Program (S) Azobenzene Resource Conservation Recovery Program (NPW) Azobenzene Resource Conservation Recovery Program (S) Benzaldehyde Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Benzaldehyde Benzidine Resource Conservation Recovery Program (NPW) Benzidine Resource Conservation Recovery Program (S) Benzo[a]anthracene Resource Conservation Recovery Program (NPW) Benzolalanthracene Resource Conservation Recovery Program (S) Benzo[a]pyrene Resource Conservation Recovery Program (NPW) Benzofalpyrene Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Benzo(b)fluoranthene Benzo[b]fluoranthene Resource Conservation Recovery Program (S) Benzo[g,h,i]perylene Resource Conservation Recovery Program (NPW) Benzo[g,h,i]perylene Resource Conservation Recovery Program (S) Benzolklfluoranthene Resource Conservation Recovery Program (NPW) Benzo[k]fluoranthene Resource Conservation Recovery Program (S) Benzoic acid Resource Conservation Recovery Program (NPW) Benzoic acid Resource Conservation Recovery Program (S) Benzyl alcohol Resource Conservation Recovery Program (NPW) Benzyl alcohol Resource Conservation Recovery Program (S) bis(2-Chloroethoxy)methane Resource Conservation Recovery Program (NPW) bis(2-Chlorpethoxy)methane Resource Conservation Recovery Program (S) bis(2-Chloroethyl)ether Resource Conservation Recovery Program (NPW) bis(2-Chloroethyl)ether Resource Conservation Recovery Program (S) bis(2-Ethylhexyl)adipate Resource Conservation Recovery Program (NPW) bis(2-Ethylhexyl)adipate Resource Conservation Recovery Program (S) bis(2-Ethylhexyl)phthalate (DEHP) Resource Conservation Recovery Program (NPW) bis(2-Ethylhexyl)phthalate (DEHP) Resource Conservation Recovery Program (S) Butyl benzyl phthalate Resource Conservation Recovery Program (NPW) Butyl benzyl phthalate Resource Conservation Recovery Program (S) Caprolactam Resource Conservation Recovery Program (NPW) Caprolactam Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Carbazole Carbazole Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Chlorobenzilate Chlorobenzilate Resource Conservation Recovery Program (S) Chrysene Resource Conservation Recovery Program (NPW) Chrysene Resource Conservation Recovery Program (S) Diallate Resource Conservation Recovery Program (NPW) Diallate Resource Conservation Recovery Program (S) Dibenz[a,h]anthracene Resource Conservation Recovery Program (NPW) Dibenz[a,h]anthracene Resource Conservation Recovery Program (S) Dibenzia ilacridine Resource Conservation Recovery Program (NPW) Dibenz[a,j]acridine Resource Conservation Recovery Program (S) Dibenzofuran Resource Conservation Recovery Program (NPW) Dibenzofuran Resource Conservation Recovery Program (S) Diethyl phthalate Resource Conservation Recovery Program (NPW) Diethyl phthalate Resource Conservation Recovery Program (S) Dimethoate Resource Conservation Recovery Program (NPW) Dimethoate Resource Conservation Recovery Program (S) Dimethyl phthalate Resource Conservation Recovery Program (NPW) Dimethyl phthalate Resource Conservation Recovery Program (S) Di-n-butyl phthalate Resource Conservation Recovery Program (NPW) Di-n-butyl phthalate Resource Conservation Recovery Program (S)

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ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Jennifer Jameson

Page 27 of 35

Di-n-octyl phthalate Resource Conservation Recovery Program (NPW) Di-n-octyl phthalate Resource Conservation Recovery Program (S) Dinoseb Resource Conservation Recovery Program (NPW) Dinoseb Resource Conservation Recovery Program (S) Disulfoton Resource Conservation Recovery Program (NPW) Disulfoton Resource Conservation Recovery Program (S) Ethyl methanesulfonate Resource Conservation Recovery Program (NPW) Ethyl methanesulfonate Resource Conservation Recovery Program (S) Famohur Resource Conservation Recovery Program (NPW) Famphur Resource Conservation Recovery Program (S) Fluoranthene Resource Conservation Recovery Program (NPW) Fluoranthene Resource Conservation Recovery Program (S) Fluorene Resource Conservation Recovery Program (NPW) Elugrene Resource Conservation Recovery Program (S) Hexachlorobenzene Resource Conservation Recovery Program (NPW) Hexachlorobenzene Resource Conservation Recovery Program (S) Hexachlorobutadiene Resource Conservation Recovery Program (NPW) Hexachlorobutadiene Resource Conservation Recovery Program (S) Hexachlorocyclopentadiene Resource Conservation Recovery Program (NPW) Hexachlorocyclopentadiene Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Hexachloroethane Resource Conservation Recovery Program (S) Hexachlorophene Resource Conservation Recovery Program (NPW) Hexachlorophene Resource Conservation Recovery Program (S) Hexachloropropene Resource Conservation Recovery Program (NPW) Hexachloropropene Resource Conservation Recovery Program (S) Indeno[1,2,3-cd]pyrene Resource Conservation Recovery Program (NPW) indeno[1,2,3-cd]pyrene Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Isodrin Resource Conservation Recovery Program (S) Isophorone Resource Conservation Recovery Program (NPW) Isophorone Resource Conservation Recovery Program (S) Isosafrole Resource Conservation Recovery Program (NPW) Isosafrole Resource Conservation Recovery Program (S) Kepone Resource Conservation Recovery Program (NPW) Kepone Resource Conservation Recovery Program (S) Methapyrilene Resource Conservation Recovery Program (NPW) Methapyrilene Resource Conservation Recovery Program (S) Methyl methanesulfonate Resource Conservation Recovery Program (NPW) Methyl methanesulfonate Resource Conservation Recovery Program (S) Methyl parathion Resource Conservation Recovery Program (NPW) Methyl parathion Resource Conservation Recovery Program (S) Naphthalene Resource Conservation Recovery Program (NPW) Naphthalene Resource Conservation Recovery Program (S) Nitrobenzene Resource Conservation Recovery Program (NPW) Nitrobenzene Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) n-Nitrosodiethylamine n-Nitrosodiethylamine Resource Conservation Recovery Program (S) n-Nitrosodimethylamine Resource Conservation Recovery Program (NPW) n-Nitrosodimethylamine Resource Conservation Recovery Program (S) n-Nitroso-di-n-butylamine Resource Conservation Recovery Program (NPW) n-Nitroso-di-n-butylamine Resource Conservation Recovery Program (S) n-Nitroso-di-n-propylamine Resource Conservation Recovery Program (NPW) n-Nitroso-dì-n-propylamine Resource Conservation Recovery Program (S) n-Nitrosodiphenylamine Resource Conservation Recovery Program (NPW) n-Nitrosodiphenylamine Resource Conservation Recovery Program (S)

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ME00019
Certificate Number:

FOT Issue Date: 6/1/2014

n-Nitrosomethylethylamine

n-Nitrosomethylethylamine

n-Nitrosomorpholine

n-Nitrosomorpholine

n-Nitrosopiperidine

Expiration Date:

6/1/2016

2014018

Jennifer Jamison, Certification Officer

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

Resource Conservation Recovery Program (S)

Page 28 of 35

n-Nitrosopiperidine	Resource Conservation Recovery Program (S)
n-Nitrosopyrrolidine	Resource Conservation Recovery Program (NPW)
n-Nitrosopyrrolidine	Resource Conservation Recovery Program (S)
o,o,o-Triethyl phosphorothioate	Resource Conservation Recovery Program (NPW)
o,o,o-Triethyl phosphorothioate	Resource Conservation Recovery Program (S)
o-Toluidine	Resource Conservation Recovery Program (NPW)
o-Toluidine	Resource Conservation Recovery Program (S)
Parathion	Resource Conservation Recovery Program (NPW)
Parathion	Resource Conservation Recovery Program (S)
Pentachiorobenzene	Resource Conservation Recovery Program (NPW)
Pentachlorobenzene	Resource Conservation Recovery Program (S)
Pentachloronitrobenzene	Resource Conservation Recovery Program (NPW)
Pentachloronitrobenzene	Resource Conservation Recovery Program (S)
Pentachlorophenol	Resource Conservation Recovery Program (NPW)
Pentachlorophenol	Resource Conservation Recovery Program (S)
Phenacetin	Resource Conservation Recovery Program (NPW)
Phenacetin	Resource Conservation Recovery Program (S)
Phenanthrene	Resource Conservation Recovery Program (NPW)
Phenanthrene	Resource Conservation Recovery Program (S)
Phenoi	Resource Conservation Recovery Program (NPW)
Phenol	Resource Conservation Recovery Program (S)
Phorate	Resource Conservation Recovery Program (NPW)
Phorate	Resource Conservation Recovery Program (\$)
p-Phenylenediamine	Resource Conservation Recovery Program (NPW)
p-Phenylenediamine	Resource Conservation Recovery Program (S)
Pronamide (Kerb)	Resource Conservation Recovery Program (NPW)
Pronamide (Kerb)	Resource Conservation Recovery Program (S)
Pyrene	Resource Conservation Recovery Program (NPW)
Pyrene Pyridine	Resource Conservation Recovery Program (S)
Pyridine	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Safrole	, ,
Safrole	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Sulfotepp	Resource Conservation Recovery Program (NPW)
Sulfotepp	Resource Conservation Recovery Program (NYVV)
EPA 8330A	resource conservation receivery in egian (a)
1,3,5-Trinitrobenzene (1,3,5-TNB)	Paccura Consequation Paccurate Brassom (NRM)
1,3,5-Trinitrobenzene (1,3,5-TNB)	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
1,3-Dinitrobenzene (1,3-DNB)	Resource Conservation Recovery Program (NPW)
1,3-Dinitrobenzene (1,3-DNB)	Resource Conservation Recovery Program (NP VV)
2,4,6-Trinitrotoluene (2,4,6-TNT)	Resource Conservation Recovery Program (NPW)
2,4,6-Trinitrotoluene (2,4,6-TNT)	Resource Conservation Recovery Program (S)
2,4-Dinitrotoluene (2,4-DNT)	Resource Conservation Recovery Program (NPW)
2,4-Dinitrotoluene (2,4-DNT)	Resource Conservation Recovery Program (NPVV)
2,6-Dinitrotoluene (2,6-DNT)	Resource Conservation Recovery Program (NPW)
2,6-Dinitrotoluene (2,6-DNT)	Resource Conservation Recovery Program (S)
2-Amino-4,6-dinitrotoluene (2-am-dnt)	Resource Conservation Recovery Program (NPW)
2-Amino-4,6-dinitrotoluene (2-am-dnt)	Resource Conservation Recovery Program (S)
2-Nitrotoluene	Resource Conservation Recovery Program (NPW)
2-Nitrotoluene	Resource Conservation Recovery Program (S)
3-Nitrotoluene	Resource Conservation Recovery Program (NPW)
3-Nitrotoluene	Resource Conservation Recovery Program (S)
4-Amino-2,6-dinitrotoluene (4-am-dnt)	Resource Conservation Recovery Program (NPW)
4-Amino-2,6-dinitrotoluene (4-am-dnt)	Resource Conservation Recovery Program (S)
4-Nitrotoluene	Resource Conservation Recovery Program (NPW)
4-Nitrotoluene	Resource Conservation Recovery Program (S)
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	Resource Conservation Recovery Program (NPW)
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	Resource Conservation Recovery Program (S)
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	Resource Conservation Recovery Program (NPW)
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	Resource Conservation Recovery Program (S)
Nitrobenzene	Resource Conservation Recovery Program (NPW)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 29 of 35

Nitrobenzene	Resource Conservation Recovery Program (S)
Nitroglycerin	Resource Conservation Recovery Program (NPW)
Nitroglycerin	Resource Conservation Recovery Program (S)
Pentaerythritoltetranitrate	Resource Conservation Recovery Program (NPW)
Pentaerythritoltetranitrate	Resource Conservation Recovery Program (S)
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	Resource Conservation Recovery Program (NPW)
RDX (Hexanydro-1,3,5-trinitro-1,3,5-triazine)	Resource Conservation Recovery Program (S)
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	Resource Conservation Recovery Program (NPW)
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	Resource Conservation Recovery Program (S)
EPA 8330B	
1,3,5-Trinitrobenzene (1,3,5-TNB)	Resource Conservation Recovery Program (NPW)
1,3,5-Trinitrobenzene (1,3,5-TNB)	Resource Conservation Recovery Program (S)
1,3-Dinitrobenzene (1,3-DNB)	Resource Conservation Recovery Program (NPW)
1,3-Dinitrobenzene (1,3-DNB)	Resource Conservation Recovery Program (S)
2,4,6-Trinitrotoluene (2,4,6-TNT)	Resource Conservation Recovery Program (NPW)
2,4,6-Trinitrotoluene (2,4,6-TNT)	Resource Conservation Recovery Program (S)
2,4-Dinitrotoluene (2,4-DNT)	Resource Conservation Recovery Program (NPW)
2,4-Dinitrotoluene (2,4-DNT)	Resource Conservation Recovery Program (S)
2,6-Dinitrotoluene (2,6-DNT)	Resource Conservation Recovery Program (NPW)
2,6-Dinitrotoluene (2,6-DNT)	Resource Conservation Recovery Program (S)
2-Amino-4,6-dinitrotoluene (2-am-dnt)	Resource Conservation Recovery Program (NPW)
2-Amino-4,6-dinitrotoluene (2-am-dnt)	Resource Conservation Recovery Program (S)
2-Nitrotoluene	Resource Conservation Recovery Program (NPW)
2-Nitrotoluene	Resource Conservation Recovery Program (S)
3,5-Dinitroaniline	Resource Conservation Recovery Program (NPW)
3,5-Dinitroaniline	Resource Conservation Recovery Program (S)
3-Nitrotoluene	Resource Conservation Recovery Program (NPW)
3-Nitrotoluene	Resource Conservation Recovery Program (S)
4-Amino-2,6-dinitrotoluene (4-am-dnt)	Resource Conservation Recovery Program (NPW)
4-Amino-2,6-dinitrotoluene (4-am-dnt) 4-Nitrotoluene	Resource Conservation Recovery Program (S)
4-Nitrotoluene	Resource Conservation Recovery Program (NPW)
	Resource Conservation Recovery Program (S)
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	Resource Conservation Recovery Program (NPW)
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	Resource Conservation Recovery Program (S)
Methyl-2,4,6-trinitrophenylnitramine (tetryl)	Resource Conservation Recovery Program (NPW)
Nitrobenzene	Resource Conservation Recovery Program (S)
Nitrobenzene	Resource Conservation Recovery Program (NPW)
Nitroglycerin	Resource Conservation Recovery Program (S)
Nitroglycerin	Resource Conservation Recovery Program (NPW)
Pentaerythritoftetranitrate	Resource Conservation Recovery Program (S)
Pentaerythritoltetranitrate	Resource Conservation Recovery Program (NPW)
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	Resource Conservation Recovery Program (\$)
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	Resource Conservation Recovery Program (NPW)
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	Resource Conservation Recovery Program (S)
EPA 9012A	resource conservation recovery i regram (6)
Total Cyanide	Passures Consequation Passures Brown (NDM)
Total Cyanide	Resource Conservation Recovery Program (NPW)
EPA 9012B	Resource Conservation Recovery Program (\$)
······································	David Community of the
Total Cyanide Total Cyanide	Resource Conservation Recovery Program (NPW)
	Resource Conservation Recovery Program (S)
EPA 9038	
Sulfate	Resource Conservation Recovery Program (NPW)
Sulfate	Resource Conservation Recovery Program (S)
EPA 9040C	
PΗ	Resource Conservation Recovery Program (S)
EPA 9045D	
Ηq	Resource Conservation Recovery Program (S)
EPA 9056A	
Bromide	Resource Conservation Recovery Program (NPW)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 30 of 35

Bromide	Resource Conservation Recovery Program (S)
Chloride	Resource Conservation Recovery Program (NPW)
Chloride	Resource Conservation Recovery Program (S)
Fluoride	Resource Conservation Recovery Program (NPW)
Fluoride	Resource Conservation Recovery Program (S)
Nitrate	Resource Conservation Recovery Program (NPW)
Nitrate	Resource Conservation Recovery Program (S)
Nitrate as N	Resource Conservation Recovery Program (NPW)
Nitrate as N Nitrite	Resource Conservation Recovery Program (S)
Natite	Resource Conservation Recovery Program (NPW)
Nitrite as N	Resource Conservation Recovery Program (S)
Nitrite as N	Resource Conservation Recovery Program (NPW)
Orthophosphate as P	Resource Conservation Recovery Program (S)
Orthophosphate as P	Resource Conservation Recovery Program (NPW)
Sulfate	Resource Conservation Recovery Program (S)
Sulfate	Resource Conservation Recovery Program (NPW)
EPA 9060A	Resource Conservation Recovery Program (S)
	S
Total Organic Carbon	Resource Conservation Recovery Program (S)
EPA 9071B	
Oil & Grease	Resource Conservation Recovery Program (S)
EPA 9251	
Chloride	Resource Conservation Recovery Program (NPW)
Chloride	Resource Conservation Recovery Program (S)
EPA RSK-175	
Ethane	Resource Conservation Recovery Program (NPW)
Ethene	Resource Conservation Recovery Program (NPW)
Methane	Resource Conservation Recovery Program (NPW)
EPA TO-15	
1,1,1-Trichloroethane	QAPP Required Air
1,1,2,2-Tetrachloroethane	QAPP Required Air
1,1,2-Trichloroethane	QAPP Required Air
1,1-Dichloroethane	QAPP Required Air
1,1-Dichloroethylene	QAPP Required Air
1,2,4-Trichlorobenzene	QAPP Required Air
1,2,4-Trìmethylbenzene	QAPP Required Air
1,2-Dibromoethane (EDB, Ethylene dibromide)	QAPP Required Air
1,2-Dichloro-1,1,2,2-tetrafluoroethane	QAPP Required Air
1,2-Dichlorobenzene	QAPP Required Air
1,2-Dichloroethane	QAPP Required Air
1,2-Dichloropropane	QAPP Required Air
1,3,5-Trimethylbenzene	QAPP Required Air
1,3-Butadiene	QAPP Required Air
1,3-Dichlorobenzene	QAPP Required Air
1,4-Dichlorobenzene	QAPP Required Air
1,4-Dioxane (1,4- Diethyleneoxide)	QAPP Required Air
2-Butanone (Methyl ethyl ketone, MEK)	QAPP Required Air
2-Hexanone	QAPP Required Air
4-Ethyltoluene	QAPP Required Air
4-Methyl-2-pentanone (MIBK)	QAPP Required Air
Acetone	QAPP Required Air
Acrolein	QAPP Required Air
Benzene	QAPP Required Air
Benzyl chloride	QAPP Required Air
Bromodichloromethane	QAPP Required Air
Bromoform	QAPP Required Air
Bromomethane (Methyl bromide)	QAPP Required Air
Carbon disulfide	QAPP Required Air
Carbon tetrachloride	QAPP Required Air
Chlorobenzene	QAPP Required Air
Chloroethane	QAPP Required Air

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Jennifer Jamison

Page 31 of 35

Chloroform QAPP Required Air cis-1,2-Dichloroethylene QAPP Required Air cis-1,3-Dichloropropene QAPP Required Air Cyclohexane QAPP Required Air Dibromochloromethane OAPP Required Air Dichlorodifluoromethane QAPP Required Air Ethanoi QAPP Required Air Ethylbenzene QAPP Required Air Freon-113 (Trichlorotrifluoroethane) QAPP Required Air Hexachlorobutadiene QAPP Required Air Isopropyl alcohol QAPP Required Air m+p-Xvlene QAPP Required Air Methyl chloride (Chloromethane) QAPP Required Air Methyl methacrylate OAPP Required Air Methyl tert-butyl ether (MTBE) QAPP Required Air Methylene chloride QAPP Required Air Naphthalene **QAPP** Required Air n-Heptane QAPP Required Air n-Hexane QAPP Required Air o-Xylene QAPP Required Air Propylene QAPP Required Air Styrene QAPP Required Air Tetrachloroethylene QAPP Required Air Tetrahydrofuran (THF) QAPP Required Air Toluene QAPP Required Air trans-1,2-Dictoroethylene QAPP Required Air QAPP Required Air trans-1,3-Dichloropropylene Trichloroethene (Trichloroethylene) **OAPP Required Air** Trichlorofluoromethane QAPP Required Air Vinyl acetate QAPP Required Air Vinvl chloride QAPP Required Air Xylene (total) QAPP Required Air

MA EPH

2-Methylnaphthalene 2-Methylnaphthalene Acenaphthene Acenaphthene Acenaphthylene Acenaphthylene Anthracene Anthracene Benzo[a]anthracene Benzo[a]anthracene Benzo[a]pyrene Benzo[a]pyrene Benzo[b]fluoranthene Benzo[b]fluoranthene Benzo[g,h,i]perylene Benzo[g,h,i]perylene Benzo[k]fluoranthene Benzo[k]fluoranthene Chrysene Chrysene Dibenz[a,h]anthracene

Dibenz[a,h]anthracene
Dibenz[a,h]anthracene
EPH Aliphatic C19-C36
EPH Aliphatic C9-C18
EPH Aliphatic C9-C18
EPH Aliphatic C9-C18
EPH Aromatic C11-C22
EPH Aromatic C11-C22

Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S) Leaking Underground Storage Tank Program (NPW) Leaking Underground Storage Tank Program (S)

Leaking Underground Storage Tank Program (NPW)

Leaking Underground Storage Tank Program (S)

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ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

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Page 32 of 35

Fluoranthene	Leaking Underground Storage Tank Program (NPW)
Fluoranthene	Leaking Underground Storage Tank Program (S)
Fluorene	Leaking Underground Storage Tank Program (NPW)
Fluorene	Leaking Underground Storage Tank Program (S)
Indeno[1,2,3-cd]pyrene	Leaking Underground Storage Tank Program (NPW)
Indeno[1,2,3-cd]pyrene	Leaking Underground Storage Tank Program (S)
Naphthalene	Leaking Underground Storage Tank Program (NPW)
Naphthalene	Leaking Underground Storage Tank Program (S)
Phenanthrene	Leaking Underground Storage Tank Program (NPW)
Phenanthrene	Leaking Underground Storage Tank Program (S)
Pyrene	Leaking Underground Storage Tank Program (NPW)
Pyrene	Leaking Underground Storage Tank Program (S)
MA VPH	
Benzene	Leaking Underground Storage Tank Program (NPW)
Benzene	Leaking Underground Storage Tank Program (S)
Ethylbenzene	Leaking Underground Storage Tank Program (NPW)
Ethylbenzene	Leaking Underground Storage Tank Program (S)
m+p-Xylene	Leaking Underground Storage Tank Program (NPW)
m+p-Xylene	Leaking Underground Storage Tank Program (S)
Methyl tert-butyl ether (MTBE)	Leaking Underground Storage Tank Program (NPW)
Methyl tert-butyl ether (MTBE)	Leaking Underground Storage Tank Program (S)
Naphthalene	Leaking Underground Storage Tank Program (NPW)
Naphthalene	Leaking Underground Storage Tank Program (S)
o-Xylene	Leaking Underground Storage Tank Program (NPW)
o-Xylene	Leaking Underground Storage Tank Program (S)
Toluene	Leaking Underground Storage Tank Program (NPW)
Toluene	Leaking Underground Storage Tank Program (S)
VPH Aliphatic C5-C8	Leaking Underground Storage Tank Program (NPW)
VPH Aliphatic C5-C8	Leaking Underground Storage Tank Program (S)
VPH Aliphatic C9-C12	Leaking Underground Storage Tank Program (NPW)
VPH Aliphatic C9-C12	Leaking Underground Storage Tank Program (S)
VPH Aromatic C9-C10	Leaking Underground Storage Tank Program (NPW)
VPH Aromatic C9-C10	Leaking Underground Storage Tank Program (S)
Xylene (total)	Leaking Underground Storage Tank Program (NPW)
Xylene (total)	Leaking Underground Storage Tank Program (S)
MADEP APH	Estating States greated states of tark (15 great (5)
1,3-Butadiene	CARR Required Air
APH Aliphatic C5-C8	QAPP Required Air
APH Aliphatic C9-C12	QAPP Required Air
APH Aromatic C9-C10	QAPP Required Air
Benzene	QAPP Required Air
Ethylbenzene	QAPP Required Air
•	QAPP Required Air
m+p-Xylene	QAPP Required Air
Methyl tert-butyl ether (MTBE)	QAPP Required Air
Naphthalene	QAPP Required Air
o-Xylene	QAPP Required Air
Toluene	QAPP Required Air
ME HETL 4.1.25	
Diesel range organics (DRO)	Leaking Underground Storage Tank Program (NPW)
Diesel range organics (DRO)	Leaking Underground Storage Tank Program (S)
ME HETL 4.2.17	
Gasoline range organics (GRO)	Leaking Underground Storage Tank Program (NPW)
Gasoline range organics (GRO)	Leaking Underground Storage Tank Program (S)
SimPlate®	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
Heterotrophic plate count	Safe Drinking Water Program (DW)
SM 2120 B 21st ED	One Distance Frequency
	Olean Markey Designs (Astronomy
Color	Clean Water Program (NPW)
Color Chi 2400 D 0414 ED	Safe Drinking Water Program (DW)
SM 2130 B 21st ED	
Turbidity	Clean Water Program (NPW)

ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 33 of 35

SM 2310 B 21st ED Acidity, as CaCO3 Clean Water Program (NPW) SM 2320 B 21st ED Alkalinity as CaCO3 Clean Water Program (NPW) Alkalinity as CaCO3 Safe Drinking Water Program (DW) SM 2340 B 21st ED Hardness Clean Water Program (NPW) SM 2540 B 21st ED Residue-total (TS) Clean Water Program (NPW) SM 2540 C 21st ED Residue-filterable (TDS) Clean Water Program (NPW) Residue-filterable (TDS) Safe Drinking Water Program (DW)

SM 2540 D 21st ED Residue-nonfilterable (TSS) Clean Water Program (NPW)

SM 2540 F 21st ED Residue-settleable Clean Water Program (NPW) SM 3500-Cr D 19th ED

Chromium VI Clean Water Program (NPW) SM 3500-Fe D 19th ED

Iron Clean Water Program (NPW)

SM 4500-Cl G 20th ED Chlorine Clean Water Program (NPW)

SM 4500-CIT E 21st ED Chloride Clean Water Program (NPW)

SM 4500-CN G 20th ED

Amenable cyanide Clean Water Program (NPW)

SM 4500-F B 21st ED Fluoride Safe Drinking Water Program (DW)

SM 4500-F C 21st ED

Fluoride Clean Water Program (NPW)

SM 4500-H+ B 21st ED рH Clean Water Program (NPW)

ρН Safe Drinking Water Program (DW) SM 4500-NH3 H 21st ED

Ammonia as N Clean Water Program (NPW)

SM 4500-P E 20th ED Orthophosphate as P

Clean Water Program (NPW) SM 4500-S2 E 18th ED

Sulfide Clean Water Program (NPW)

SM 4500-S2 F 21st ED

Sulfide Clean Water Program (NPW) SM 4500-SO3 B 21st ED

Sulfite Clean Water Program (NPW)

SM 5210 B 21st ED Biochemical oxygen demand Clean Water Program (NPW)

Carbonaceous BOD, CBOD Clean Water Program (NPW) SM 5310 B 21st ED

Total Organic Carbon Clean Water Program (NPW)

SM 5540 C 20th ED Surfactants - MBAS

Clean Water Program (NPW) SM 9222 D (m-FC) 21st ED

Fecal coliforms Clean Water Program (NPW) Fecal coliforms Safe Drinking Water Program (DW)

SM 9223 B (Colilert® Quanti-Tray®) 21st ED

Escherichia coli Clean Water Program (NPW) Escherichia coli Safe Drinking Water Program (DW) Total coliforms Safe Drinking Water Program (DW)

SM 9223 B (Colilert®) 21st ED

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ME00019

Jennifer Jameson Certificate Number: 2014018 Jennifer Jamison, Certification Officer FOT Issue Date: 6/1/2014 **Expiration Date:** 6/1/2016 Page 34 of 35

Escherichia coti
Total coliforms

SM 9223 B (Colilert®-18 Quanti-Tray®) 21st ED
Escherichia coli

Safe Drinking Water Program (DW) Safe Drinking Water Program (DW)

Clean Water Program (NPW)

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ME00019

Certificate Number: 2014018 FOT Issue Date: 6/1/2014 Expiration Date: 6/1/2016

Jennifer Jamison, Certification Officer

Page 35 of 35



PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 4.2 10/26/2010 and is accredited is accordance with the:

United States Department of Defense Environmental Laboratory Accreditation Program (DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Tracy Szerszen

 ${\it Initial\ Accreditation\ Date:}$

Issue Date:

Expiration Date:

January 22, 2010

January 31, 2014

March 31, 2016

Accreditation No.:

Certificate No.:

65817

L14-36

Perry Johnson Laboratory Accreditation, Inc. (PJLA) 755 W. Big Beaver, Suite 1325 Troy, Michigan 48084

President/Operations Manager

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com





ALS Environmental-Rochester

1565 Jefferson Road, Building 300, Suite 360, Rochester, NY 14623 Lisa Reyes Phone: 585-288-5380

Matrix	Standard/Method	Technology	Analyte
Aqueous	EPA 218.6	IC-UV	Chromium, Hexavalent
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8270D	GC-MS-SIM	1,4-Dioxane
Aqueous	EPA 9040C	POT	рН
Aqueous	RSK-175	GC-FID	Ethane
Aqueous	RSK-175	GC-FID	Ethylene
Aqueous	RSK-175	GC-FID	Methane
Aqueous	RSK-175	GC-FID	Propane
Aqueous	RSK-175	GC-FID	Acetylene
Solids	EPA Lloyd Kahn	UV-VIS	Total organic carbon
Solids	EPA 7471B	CVAA	Mercury
Solids	EPA 9045D	POT	рН
Aqueous/Solids	EPA 1010A	Pensky Martin	Ignitability
Aqueous/Solids	EPA 6010C	ICP-AES	Aluminum
Aqueous/Solids	EPA 6010C	ICP-AES	Antimony
Aqueous/Solids	EPA 6010C	ICP-AES	Arsenic
Aqueous/Solids	EPA 6010C	ICP-AES	Barium
Aqueous/Solids	EPA 6010C	ICP-AES	Beryllium
Aqueous/Solids	EPA 6010C	ICP-AES	Boron
Aqueous/Solids	EPA 6010C	ICP-AES	Cadmium
Aqueous/Solids	EPA 6010C	ICP-AES	Calcium
Aqueous/Solids	EPA 6010C	ICP-AES	Chromium
Aqueous/Solids	EPA 6010C	ICP-AES	Cobalt
Aqueous/Solids	EPA 6010C	ICP-AES	Copper
Aqueous/Solids	EPA 6010C	ICP-AES	Iron
Aqueous/Solids	EPA 6010C	ICP-AES	Lead
Aqueous/Solids	EPA 6010C	ICP-AES	Magnesium
Aqueous/Solids	EPA 6010C	ICP-AES	Manganese
Aqueous/Solids	EPA 6010C	ICP-AES	Nickel
Aqueous/Solids	EPA 6010C	ICP-AES	Potassium





ALS Environmental-Rochester

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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 6010C	ICP-AES	Selenium
Aqueous/Solids	EPA 6010C	ICP-AES	Silver
Aqueous/Solids	EPA 6010C	ICP-AES	Sodium
Aqueous/Solids	EPA 6010C	ICP-AES	Thallium
Aqueous/Solids	EPA 6010C	ICP-AES	Tin
Aqueous/Solids	EPA 6010C	ICP-AES	Vanadium
Aqueous/Solids	EPA 6010C	ICP-AES	Zinc
Aqueous/Solids	EPA 6020A	ICP-MS	Arsenic
Aqueous/Solids	EPA 6020A	ICP-MS	Antimony
Aqueous/Solids	EPA 6020A	ICP-MS	Barium
Aqueous/Solids	EPA 6020A	ICP-MS	Beryllium
Aqueous/Solids	EPA 6020A	ICP-MS	Cadmium
Aqueous/Solids	EPA 6020A	ICP-MS	Chromium
Aqueous/Solids	EPA 6020A	ICP-MS	Cobalt
Aqueous/Solids	EPA 6020A	ICP-MS	Copper
Aqueous/Solids	EPA 6020A	ICP-MS	Lead
Aqueous/Solids	EPA 6020A	ICP-MS	Manganese
Aqueous/Solids	EPA 6020A	ICP-MS	Nickel
Aqueous/Solids	EPA 6020A	ICP-MS	Selenium
Aqueous/Solids	EPA 6020A	ICP-MS	Silver
Aqueous/Solids	EPA 6020A	ICP-MS	Thallium
Aqueous/Solids	EPA 6020A	ICP-MS	Vanadium
Aqueous/Solids	EPA 6020A	ICP-MS	Zinc
Aqueous/Solids	EPA 6850	HPLC-MS	Perchlorate
Aqueous/Solids	EPA 7199	IC-UV	Chromium, hexavalent
Aqueous/Solids	EPA 8081B	GC-ECD	4,4'-DDD
Aqueous/Solids	EPA 8081B	GC-ECD	4,4'-DDE
Aqueous/Solids	EPA 8081B	GC-ECD	4,4'-DDT
Aqueous/Solids	EPA 8081B	GC-ECD	Aldrin
Aqueous/Solids	EPA 8081B	GC-ECD	α–ВНС
Aqueous/Solids	EPA 8081B	GC-ECD	Alpha-chlordane





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8081B	GC-ECD	β–ВНС
Aqueous/Solids	EPA 8081B	GC-ECD	Chlordane, technical
Aqueous/Solids	EPA 8081B	GC-ECD	δ–ВНС
Aqueous/Solids	EPA 8081B	GC-ECD	Dieldrin
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan I
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan II
Aqueous/Solids	EPA 8081B	GC-ECD	Endosulfan sulfate
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin aldehyde
Aqueous/Solids	EPA 8081B	GC-ECD	Endrin ketone
Aqueous/Solids	EPA 8081B	GC-ECD	Gamma-BHC (Lindane)
Aqueous/Solids	EPA 8081B	GC-ECD	Gamma-chlordane
Aqueous/Solids	EPA 8081B	GC-ECD	Heptachlor
Aqueous/Solids	EPA 8081B	GC-ECD	Heptachlor epoxide
Aqueous/Solids	EPA 8081B	GC-ECD	Hexachlorobenzene
Aqueous/Solids	EPA 8081B	GC-ECD	Methoxychlor
Aqueous/Solids	EPA 8081B	GC-ECD	Toxaphene
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1016
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1221
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1232
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1242
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1248
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1254
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1260
Aqueous/Solids	EPA 8082A	GC-ECD	PCB 1268
Aqueous/Solids	EPA 8260C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	1,1,2-Trichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	1,1-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dibromo-3-chloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dibromoethane
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloroethane
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloroethene, total
Aqueous/Solids	EPA 8260C	GC-MS	1,2-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,3-Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,3-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	1,4-Dichlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	1,4-Dioxane
Aqueous/Solids	EPA 8260C	GC-MS	2,2-Dichloropropane
Aqueous/Solids	EPA 8260C	GC-MS	2-Butanone (MEK)
Aqueous/Solids	EPA 8260C	GC-MS	2-Chloroethylvinyl ether
Aqueous/Solids	EPA 8260C	GC-MS	2-Chlorotoluene
Aqueous/Solids	EPA 8260C	GC-MS	2-Hexanone
Aqueous/Solids	EPA 8260C	GC-MS	4-Chlorotoluene
Aqueous/Solids	EPA 8260C	GC-MS	4-Isopropyltoluene
Aqueous/Solids	EPA 8260C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solids	EPA 8260C	GC-MS	Acetone
Aqueous/Solids	EPA 8260C	GC-MS	Benzene
Aqueous/Solids	EPA 8260C	GC-MS	Bromobenzene





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	Bromochloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Bromodichloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Bromoform
Aqueous/Solids	EPA 8260C	GC-MS	Bromomethane
Aqueous/Solids	EPA 8260C	GC-MS	Carbon disulfide
Aqueous/Solids	EPA 8260C	GC-MS	Carbon tetrachloride
Aqueous/Solids	EPA 8260C	GC-MS	Chlorobenzene
Aqueous/Solids	EPA 8260C	GC-MS	Chloroethane
Aqueous/Solids	EPA 8260C	GC-MS	Chloroform
Aqueous/Solids	EPA 8260C	GC-MS	Chloromethane
Aqueous/Solids	EPA 8260C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	cis-1,3-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	Cyclohexane
Aqueous/Solids	EPA 8260C	GC-MS	Dibromochloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Dibromomethane
Aqueous/Solids	EPA 8260C	GC-MS	Dichlorodifluoromethane (Freon 12)
Aqueous/Solids	EPA 8260C	GC-MS	Dichloromethane
Aqueous/Solids	EPA 8260C	GC-MS	Ethylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8260C	GC-MS	Isopropylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	m- + p-Xylene
Aqueous/Solids	EPA 8260C	GC-MS	Methyl acetate
Aqueous/Solids	EPA 8260C	GC-MS	Methylcyclohexane
Aqueous/Solids	EPA 8260C	GC-MS	Methyl-tert-butyl ether (MTBE)
Aqueous/Solids	EPA 8260C	GC-MS	Napthalene
Aqueous/Solids	EPA 8260C	GC-MS	N-butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	N-propylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	o-Xylene
Aqueous/Solids	EPA 8260C	GC-MS	sec-butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Styrene





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8260C	GC-MS	tert-butylbenzene
Aqueous/Solids	EPA 8260C	GC-MS	Tetrachloroethene
Aqueous/Solids	EPA 8260C	GC-MS	Toluene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solids	EPA 8260C	GC-MS	Trichloroethene
Aqueous/Solids	EPA 8260C	GC-MS	Trichlorofluoromethane (Freon 11)
Aqueous/Solids	EPA 8260C	GC-MS	Vinyl chloride
Aqueous/Solids	EPA 8260C	GC-MS	Xylenes, total
Aqueous/Solids	EPA 8270D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2-Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,2-Diphenylhydrazine
Aqueous/Solids	EPA 8270D	GC-MS	1,3-Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1,4-Dichlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	1-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dimethylphenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dinitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8270D	GC-MS	2,6-Dichlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8270D	GC-MS	2-Chloronaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2-Chlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Methylnaphthalene
Aqueous/Solids	EPA 8270D	GC-MS	2-Methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	2-Nitroaniline





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	2-Nitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	3,3'-Dichlorobenzidine
Aqueous/Solids	EPA 8270D	GC-MS	3+4-Methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	3-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4,6-Dinitro-2-methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solids	EPA 8270D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solids	EPA 8270D	GC-MS	4-Chloroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitroaniline
Aqueous/Solids	EPA 8270D	GC-MS	4-Nitrophenol
Aqueous/Solids	EPA 8270D	GC-MS	Acenaphthene
Aqueous/Solids	EPA 8270D	GC-MS	Acenaphthylene
Aqueous/Solids	EPA 8270D	GC-MS	Acetophenone
Aqueous/Solids	EPA 8270D	GC-MS	Anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Atrazine
Aqueous/Solids	EPA 8270D	GC-MS	Benzaldehyde
Aqueous/Solids	EPA 8270D	GC-MS	Benzidine
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(a)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(a)pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solids	EPA 8270D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Benzoic acid
Aqueous/Solids	EPA 8270D	GC-MS	Benzyl alcohol
Aqueous/Solids	EPA 8270D	GC-MS	Biphenyl
Aqueous/Solids	EPA 8270D	GC-MS	Bis(1-chloroisopropyl)ether
Aqueous/Solids	EPA 8270D	GC-MS	Bis(-2-chloroethoxy)methane
Aqueous/Solids	EPA 8270D	GC-MS	Bis(2-chloroethyl)ether
Aqueous/Solids	EPA 8270D	GC-MS	Bis(2-ethylhexyl)phthalate





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8270D	GC-MS	Butyl benzyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Caprolactam
Aqueous/Solids	EPA 8270D	GC-MS	Carbazole
Aqueous/Solids	EPA 8270D	GC-MS	Chrysene
Aqueous/Solids	EPA 8270D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solids	EPA 8270D	GC-MS	Dibenzofuran
Aqueous/Solids	EPA 8270D	GC-MS	Diethylphthalate
Aqueous/Solids	EPA 8270D	GC-MS	Dimethyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Di-n-butylphthalate
Aqueous/Solids	EPA 8270D	GC-MS	Di-n-octyl phthalate
Aqueous/Solids	EPA 8270D	GC-MS	Fluoranthene
Aqueous/Solids	EPA 8270D	GC-MS	Fluorene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorobenzene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorobutadiene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachlorocyclopentadiene
Aqueous/Solids	EPA 8270D	GC-MS	Hexachloroethane
Aqueous/Solids	EPA 8270D	GC-MS	Indeno(1,2,3-cd)pyrene
Aqueous/Solids	EPA 8270D	GC-MS	Isophorone
Aqueous/Solids	EPA 8270D	GC-MS	Naphthalene
Aqueous/Solids	EPA 8270D	GC-MS	Nitrobenzene
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodiethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodimethylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodi-n-butylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitroso-di-n-propylamine
Aqueous/Solids	EPA 8270D	GC-MS	N-nitrosodiphenylamine
Aqueous/Solids	EPA 8270D	GC-MS	Pentachlorophenol
Aqueous/Solids	EPA 8270D	GC-MS	Phenanthrene
Aqueous/Solids	EPA 8270D	GC-MS	Phenol
Aqueous/Solids	EPA 8270D	GC-MS	Pyrene
Aqueous/Solids	EPA 8330B	HPLC	1,3,5-Trinitrobenzene





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Matrix	Standard/Method	Technology	Analyte
Aqueous/Solids	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	2,4,6-Trinitrotoluene (TNT)
Aqueous/Solids	EPA 8330B	HPLC	2,4-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2-Amino 4,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solids	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	4-Amino 2,6-Dinitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solids	EPA 8330B	HPLC	Hexahydro 1,3,5-Trinitro 1,3,5- Triazine
Aqueous/Solids	EPA 8330B	HPLC	Methyl 2,4,6 Trinitrophenylnitramine
Aqueous/Solids	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solids	EPA 8330B	HPLC	Nitroglycerin
Aqueous/Solids	EPA 8330B	HPLC	Octahydro 1.3.5.7 Tetranitro 1,3,5,7 Tetraz
Aqueous/Solids	EPA 8330B	HPLC	Pentaerythritol Tetranitrate (PETN)
Aqueous/Solids	EPA 9034	Titration	Sulfide, Acid Soluble
Aqueous/Solids	HPLC-METACID	HPLC	Acetic Acid
Aqueous/Solids	HPLC-METACID	HPLC	Butanoic Acid (Butyric Acid)
Aqueous/Solids	HPLC-METACID	HPLC	Lactic Acid
Aqueous/Solids	HPLC-METACID	HPLC	Propionic Acid
Aqueous/Solids	HPLC-METACID	HPLC	Pyruvic Acid

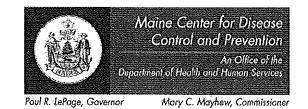




ALS Environmental-Rochester

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Matrix	Standard/Method	Technology	Analyte
Aqueous	(ALS SOP)	SPE Extraction	1,4-Dioxane
Aqueous	EPA 3010A	Acid Digestion	Metals prep
Aqueous	EPA 3510C	SF Extraction	Semivolatiles, pesticides, PCBs, DRO
Aqueous	EPA 5030B	P&T	Volatiles
Aqueous	EPA 3535A	SPE Extraction	Explosives
Solids	EPA 3050B	Acid Digestion	Metals prep
Solids	EPA 3060A	Digestion	Hexavalent chromium digestion
Solids	EPA 3541	SOX Extraction	Semivolatiles, pesticides, PCBs, DRO
Solids	EPA 5035	P&T closed	Volatiles
Aqueous/Solids	EPA 1311	TCLP	Physical Extraction
Aqueous/Solids	EPA 1312	SPLP	Physical Extraction
Aqueous/Solids	EPA 3620B	Florisil Cleanup	Semivolatiles, pesticides, PCBs
Aqueous/Solids	EPA 3660B	Sulfur Cleanup	Semivolatiles, pesticides, PCBs
Aqueous/Solids	EPA 3665A	Sulfuric Acid Cleanup	PCBs
Aqueous/Solids	EPA 9030B	Distillation	Sulfide, Acid Soluble



Department of Health and Human Services Maine Center for Disease Control and Prevention 286 Water Street 11 State House Station Augusta, Maine 04333-0011 Tel. (207) 287-8016 Fax (207) 287-9058; TTY (800) 606-0215

> Drinking Water Program Tel. (207) 287-2070 Fax (207) 287-4172

Vicky Collom ALS Environmental 1656 Jefferson Road, Building 300, Suite 360 Rochester, NY 14625

May 13, 2014

Dear Ms. Collom,

Thank you for participating in the Maine Certification program.

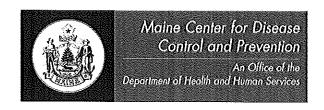
Please find enclosed a current Field of Testing list to cover your laboratory for this certification period.

If you have any questions, please feel free to contact me at (207) 287-1929 or by e-mail at jennifer.jamison@maine.gov.

Sincerely,

Jennifer Jamison Laboratory Certification Officer 286 Water Street, 3rd Floor Augusta, ME 04333-0011

Jennyler Jamuson



Department of Health and Human Services Maine Center for Disease Control and Prevention 286 Water Street #11 State House Station Augusta, Maine 04333-0011

Tel: (207) 287-1929; Fax: (207) 287-4172

(585) 288-5380

Field of Testing Summary for:

ALS Envrironmental - Rochester

1565 Jefferson Road, Bldg 300, Suite 360

NY

As required by 22 M.R.S.A Chapter 157-A the laboratory demonstrated the capability to analyze analyses under 10-144 CMR 263, the rules for laboratory certification and is hereby granted certification for:

Conductivity

EPA 1664A

Oil & Grease

EPA 1664A (HEM)

n-Hexane Extractable Material (O&G)

EPA 200.7 4.4 Aluminum

Antimony

Arsenic

Barium Barium

Beryllium

Beryllium Boron

Cadmium

Cadmium

Calcium Chromium

Chromium

Cobalt Copper

Copper

Iron

Iron Lead

Magnesium

Manganese

Manganese

Molybdenum

Nickel

Nickel Potasstum

Selenium

Silver

Silver Sodium

Sodium

Thallium

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Vanadium Zinc

Clean Water Program (NPW)

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Clean Water Program (NPW)

Clean Water Program (NPW)

Clean Water Program (NPW)

Clean Water Program (NPW)

Safe Drinking Water Program (DW)

To be considered valid, this Fields of Testing Summary must be displayed with a current certificate.

NY01587

Certificate Number: 2013033 FOT Issue Date: **Expiration Date:**

5/13/2014

11/12/2014

Jennifer Jamison, Certification Officer

Page 1 of 14

EPA 200.8 5.4 Antimony Antimony Arsenic Arsenic Barium Barium Beryllium Beryllium Cadmium Cadmium Chromium Chromium Cobalt Copper Copper Lead Lead Manganese Manganese Molybdenum Nicket Nickel Selenium Selenium Silver Silver Thallium Thallium Vanadium Zinc Zinc EPA 245.13 Mercury Mercury EPA 300.0 2.1 Bromide Chloride Chloride Fluoride Fluoride Nitrate as N Nitrite as N Sulfate Sulfate EPA 335.4 Total Cyanide Total Cyanide EPA 350.1 2 Ammonia as N EPA 351.2 2 Kjeloahl nitrogen - total EPA 353.2 2 Nitrate as N Nitrate as N

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Certificate Number: FOT Issue Date:

Nitrite as N

Nitrite as N

Orthophosphate as P

EPA 365.1 2 Orthophosphate as P

> 2013033 5/13/2014

Expiration Date:

11/12/2014

Jennifer Jamison, Certification Officer

Jennifer Jannison

Page 2 of 14

Phosphorus, total EPA 410.4 2

Chemical oxygen demand

EPA 420.4 Total Phenolics

EPA 6010C

Aluminum

Aluminum

Antimony

Antimony

Arsenic

Arsenic

Barium

Barium

Bervilium

Beryllium Boron Boron Cadmium Cadmium Calcium Calcium

Chromium Chromium Cobalt Cobalt Copper Copper

Lead Lead Magnesium Magnesium Manganese

Iron

Manganese Molybdenum Molybdenum Nickel Nickel

Potassium Potassium Selenium Selenium Silver Silver

Sodium Sodium Strontium Strontium

Thallium Thallium Tin Tin

Titanium Titanium Vanadium Vanadium

Zinc Zinc EPA 6020A Clean Water Program (NPW)

Clean Water Program (NPW)

Clean Water Program (NPW)

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)

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NY01587

Certificate Number: 2013033 FOT Issue Date: 5/13/2014 Expiration Date: 11/12/2014

Jennifer Jamison, Certification Officer

Jennifer Jamuson

Page 3 of 14

Antimony	Resource Conservation Recovery Program (NPW)
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Arsenic	Resource Conservation Recovery Program (NPW)
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Barium	Resource Conservation Recovery Program (NPW)
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Lead	Resource Conservation Recovery Program (S)
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Manganese	Resource Conservation Recovery Program (S)
Molybdenum	Resource Conservation Recovery Program (NPW)
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Nickel	Resource Conservation Recovery Program (NPW)
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Silver	Resource Conservation Recovery Program (NPW)
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EPA 7196A 1	
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EPA 7471B	· · · · · · · · · · · · · · · · · · ·
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EPA 8015C	resource conservation receivery ringram (5)
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	Resource Conservation Recovery Program (NPW)
Isobutyl alcohol	Resource Conservation Recovery Program (NPW)
<u>EPA 8081B</u>	
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4,4'-DDT	Resource Conservation Recovery Program (NPW)
4,4 ⁻ DDT	Resource Conservation Recovery Program (S)
Aldrin	Resource Conservation Recovery Program (NPW)
Aldrin	Resource Conservation Recovery Program (S)
alpha-BHC	Resource Conservation Recovery Program (NPW)
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alpha-Chlordane	Resource Conservation Recovery Program (NPW)
alpha-Chlordane	Resource Conservation Recovery Program (S)
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NY01587

Certificate Number: 2013033 FOT Issue Date: 5/13/2014 Expiration Date: 11/12/2014

Jennifer Jamison, Certification Officer

Page 4 of 14

beta-BHC beta-BHC Chlordane (tech.) Chlordane (tech.) delta-BHC delta-BHC Dieldrin Dieldrin Endosulfan I Endosulfan I Endosulfan II Endosulfan li Endosulfan sulfate Endosulfan sulfate Endrin Endrin Endrin aldehyde Endrin aldehyde Endrin ketone Endrin ketone gamma-BHC gamma-BHC gamma-Chlordane gamma-Chlordane Heptachtor Heptachlor Heptachlor ecoxide Heptachlor epoxide Hexachlorobenzene Methoxychlor Methoxychlor Toxaphene Toxaphene EPA 8082A Aroclor-1016 (PCR-1016) Aroclor-1016 (PCB-1016) Aroclor-1221 (PCB-1221) Aroclor-1221 (PCB-1221) Aroclor-1232 (PCB-1232) Aroclor-1232 (PCB-1232) Aroclor-1242 (PCB-1242) Aroclor-1242 (PCB-1242) Aroclor-1248 (PCB-1248) Aroclor-1248 (PCB-1248) Arocior-1254 (PCB-1254) Aroctor-1254 (PCB-1254) Aroclor-1260 (PCB-1260) Aroclor-1260 (PCB-1260) Aroclor-1262 (PCR 1262) Aroclor-1262 (PCB 1262) Aroclor-1268 (PCB-1268) Aroclor-1268 (PCB-1268) EPA 8151A 2,4,5-T 2,4,5-T 2.4-D 2,4-D Dicamba Dicamba Dinoseb Pentachtorophenol

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)

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NY01587 Certificate Number:

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2013033 5/13/2014 11/12/2014

Jennifer Jamison, Certification Officer

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Page 5 of 14

Pentachlorophenol Silvex (2.4.5-TP) Silvex (2,4,5-TP) EPA 8260C

1,1,1,2-Tetrachloroethane 1,1,1,2-Tetrachloroethane 1,1,1-Trichloroethane

1.1.1-Trichloroethane 1,1,2,2-Tetrachloroethane 1,1,2,2-Tetrachloroethane

1,1,2-Trichloro-1,2,2-trifluoroethane

1,1,2-Trichloro-1,2,2-trifluoroethane

1.1.2-Trichloroethane 1,1,2-Trichloroethane 1.1-Dichloroethane 1,1-Dichloroethane 1,1-Dichloroethylene 1,1-Dichloroethylene 1,1-Dichtoropropene 1,1-Dichioropropene 1,2,3-Trichlorobenzene 1.2.3-Trichlorobenzene 1,2,3-Trichloropropane 1,2,3-Trichloropropane 1.2.4-Trich!orobenzene 1,2,4-Trichlorobenzene

1,2,4-Trimethylbenzene 1.2-Dibromo-3-chloropropane (DBCP) 1,2-Dibromo-3-chloropropane (DBCP) 1,2-Dibromoethane (EDB, Ethylene dibromide)

1,2-Dibromoethane (EDB, Ethylene dibromide)

1,2-Dichloro-1,1,2-trifluoroethane

1.2-Dichlorobenzene 1,2-Dichlorobenzene 1.2-Dichloroethane 1,2-Dichloroethane 1,2-Dichloropropane 1.2-Dichloropropane 1,3,5-Trimethylbenzene 1,3,5-Trimethylbenzene 1,3-Dichterobenzene

1.2.4-Trimethylbenzene

1.3-Dichlorobenzene 1,3-Dichloropropane 1,3-Dichtoropropane

1.4-Dichtorobenzene 1.4-Dichlorobenzene

1,4-Dioxane (1,4-Diethyleneoxide) 1,4-Dioxane (1,4- Diethyleneoxide)

1.4-Isopropyltoluene 2,2-Dichloropropane 2,2-Dichloropropane

2-Butanone (Methyl ethyl ketone, MEK) 2-Butanone (Methyl ethyl ketone, MEK) 2-Chloro-1,3-butadiene (Chloroprene)

2-Chloro-1,3-butadiene (Chloroprene)

2-Chloroethyl vinyl ether 2-Chloroethyl vinyl ether

2-Chlorotoluene 2-Chlorotoluene

2-Hexanone

Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)

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NY01587

Certificate Number: 2013033 FOT Issue Date: 5/13/2014 **Expiration Date:** 11/12/2014

Jennifer Jamison, Certification Officer

Page 6 of 14

4-Chlorotoluene 4-Chlorotoluene 4-Methyl-2-pentanone (MIBK) 4-Methyl-2-pentanone (MIBK) Acetone Acetone Acetonitrite Acetonitrile Acrolein Acrolein Acrylonitrile Acrylonitrile Allyl chloride Allyl chloride Benzene Benzene Bromobenzene Bromochloromethane Bromochloromethane Bromodichloromethane **Bromodichloromethane** Bromoform Bromoform Bromomethane (Methyl bromide) Bromomethane (Methyl bromide) Carbon disulfide Carbon disulfide

2-Haxanona

Carbon tetrachloride
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloroform
Chloroprene
cis & trans-1,2-Dichloroethene
cis-1,2-Dichloroethylene
cis-1,3-Dichloropropene
cis-1,3-Dichloropropene
cis-1,3-Dichloropropene
Cyclohexane

Dibromochloromethane
Dibromomethane
Dibromomethane
Dibromomethane
Dichlorodifluoromethane
Dichlorodifluoromethane
Dispropylether (DIPE)
Ethyl methacrylate
Ethyl methacrylate
Ethylibenzene
Ethyl-tert-butyl ether (ETBE)

Cyclohexane

Hexachlorobutadiene Hexachlorobutadiene Iodomethane (Methyl iodide) Iodomethane (Methyl iodide) Isobutyl alcohol

Isobutyl alcohol

Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)

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2013033 5/13/2014 11/12/2014 Jennyer Jameson

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Resource Conservation Recovery Program (S)

Page 7 of 14

Isopropylbenzene Isopropylbenzene Methacrytonitrile Methacrylonitrile Methyl acetate Methyl acetate Methyl chloride (Chloromethane) Methyl chloride (Chloromethane) Methyl methacrylate Methyl methacrylate Methyl tert-butyl ether (MTBE) Methyl tert-butyl ether (MTBE) Methylcyclohexane Methylcyclohexane Methylene chloride Methylene chloride Nachthalene Naphthalene n-Butylbenzene n-Butylbenzene n-Propylbenzene n-Propylbenzene p-Isopropyltoluene Propionitrile (Ethyl cyanide) Propionitrile (Ethyl cyanide) sec-Butvlbenzene sec-Butylbenzene Styrene Styrene tert-Amyl methyl ether (TAME) tert-Butyl alcohol

tert-Butyl alcohol tert-Butylbenzene tert-Butylbenzene Tetrach!oroethylene Tetrachtoroethylene Toluene Toluene

trans-1,2-Dicloroethylene trans-1,2-Dickoroethylene trans-1,3-Dichloropropylene trans-1,3-Dichloropropylene trans-1.4-Dichloro-2-butene trans-1,4-Dichloro-2-butene Trichloroethene (Trichloroethylene) Trichloroethene (Trichloroethylene) Trichlorofluoromethane

Trichlorofluoromethane Vinyl acetate Vinyl acetate Vinyl chloride Vinyl chloride Xylene (total) Xylene (total)

EPA 8270D

1,1'-Biphenyl 1,1'-Biphenyl

1.2.4.5-Tetrachloropenzene

1,2,4,5-Tetrachlorobenzene

1,2,4-Trichlorobenzene

1.2.4-Trichlorobenzene

Resource Conservation Recovery Program (NPW)

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Certificate Number: FOT Issue Date: **Expiration Date:**

2013033 5/13/2014 11/12/2014

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Jennyla Jamuson

Page 8 of 14

1.2-Dichlorobenzene 1,2-Dichlorobenzene 1,2-Diphenylhydrazine 1,3,5-Trinitrobenzene (1,3,5-TNB) 1,3,5-Trinitrobenzene (1,3,5-TNB) 1.3-Dichlorobenzene 1,3-Dichlorobenzene 1,3-Dinitrobenzene (1,3-DNB) 1,3-Dinitrobenzene (1,3-DNB) 1,4-Dichlorobenzene 1.4-Dichlorobenzene 1,4-Naphthoquinone 1.4-Naphthoguinone 1,4-Phenylenediamine 1.4-Phenylenediamine 1-Naphthylamine 1-Naphthylamine 2,2'-Oxybis(1-chloropropane) 2,2'-Oxybis(1-chloropropane) 2,3,4,6-Tetrachlorophenol 2,3,4,6-Tetrachlorophenol 2.4.5-Trichlorophenol 2,4,5-Trichlorophenol 2,4,6-Trichlorophenol 2.4.6-Trichlorophenol 2,4-Dichlorophenol 2.4-Dichlorophenol 2,4-Dimethylphenol 2.4-Dimethylphenol 2,4-Dinitrophenol 2,4-Dinitrophenol 2,4-Dinitrotoluene (2,4-DNT) 2,4-Dinitrotoluene (2,4-DNT) 2,6-Dichlorophenol 2,6-Dichlorophenol 2.6-Dinitrotoluene (2.6-DNT) 2,6-Dinitrotoluene (2,6-DNT) 2-Chloronaphthalene 2-Chloronaphthalene 2-Chlorophenoi 2-Chlorophenol 2-Methyl-4,6-dinitrophenol 2-Methyl-4,6-dinitrophenol 2-Methylnaphthalene 2-Methylnaphthalene 2-Methylphenol (o-Cresoi) 2-Methylphenol (o-Cresol) 2-Naohthylamine 2-Naphthylamine 2-Nitroaniline 2-Nitroanitine 2-Nitrophenol 2-Nitrophenol 3 & 4 Methylphenol 3 3'-Dichlorobenzidine 3.3'-Dichlorobenzidine 3,3'-Dimethylbenzidine 3,3'-Dimethylbenzidine 3-Methylcholanthrene 3-Methylcholanthrene

Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)

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3-Methylphenol (m-Cresol)

Certificate Number: 2013033 5/13/2014

Expiration Date:

11/12/2014

Jennifer Jamison, Certification Officer

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Page 9 of 14

3-Nitroaniline 3-Nitroaniline 4.6-Dinitro-2-methylchenol 4,6-Dinitro-2-methylphenol 4-Aminobiphenyl 4-Aminobiphenyl 4-Bromophenyl phenyl ether 4-Bromophenyl phenyl ether 4-Chloro-3-methylphenol 4-Chloro-3-methylphenol 4-Chloroaniline 4-Chloroanitine 4-Chlorophenyl phenylether 4-Chlorophenyl phenylether 4-Dimethyl aminoazobenzene 4-Dimethyl aminoazobenzene 4-Methylohenol (p-Cresol) 4-Methylphenol (p-Cresol) 4-Nitroanitine 4-Nitroaniline 4-Nitrophenol 4-Nitrophenol 5-Nitro-o-toluidine 5-Nitro-o-toluidine 7,12-Dimethylbenz[a]anthracene 7,12-Dimethylbenz[a]anthracene Acenaphthene Acenaphthene Acenaphthylene Acenaphthylene Acetophenone Acetophenone Aniline Anthracene Anthracene

Aramite Atrazine Atrazine Benzaldehyde Benzaldehyde Benzidine Benzidine Benzolalanthracene Benzo[a]anthracene Benzolalpyrene Benzo[a]pyrene Benzo[b]fluoranthene Benzo[b]fluoranthene Benzo[g.h,i]perylene Benzo[g,h,i]perylene Benzo[k]fluoranthene Benzo[k]fluoranthene Benzoic acid Benzoic acid Benzyl alcohol Benzyl alcohol Biphenyl

Biphenyl bis(2-Chloroethoxy)methane bis(2-Chloroethoxy)methane bis(2-Chloroethyl)ether

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S)

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Resource Conservation Recovery Program (NPW)

Page 10 of 14

bis(2-Chloroethyl)ether bis(2-Chloroisopropyl)ether bis(2-Ethylhexyl)phthalate (DEHP) bis(2-Ethylhexyl)phthalate (DEHP) Butyl benzyl phthalate Butyl benzyl phthalate Caprolactam Caprolactam Carbazole Carbazole Chlorobenzilate Chlorobenzilate Chrysene Chrysene Diallate Diallate Dibenz[a,h]anthracene Dibenz[a,h]anthracene Dibenzofuran Dibenzofuran Diethyl phthalate Diethyl phthalate Dimethoate Dimethoate Dimethyl phthalate Dimethyl phthalate Di-n-butyl phthalate Di-n-butyl phthalate Di-n-octyl phthalate Di-n-octvl phthalate Dinoseb Dinoseb Diphenylamine Diphenylamine Disulfoton Disulfoton Ethyl methanesulfonate Ethyl methanesulfonate Ethyl parathion Ethyl parathion Fluoranthene Fluoranthene Fluorene Fluorene Hexachlorobenzene Hexachlorobenzene Hexachlorobutadiene Hexachlorobutadiene Hexachlorocyclopentadiene Hexachlorocyclopentadiene Hexachloroethane Hexachloroethane Hexachlorophene Hexachloropropene Hexachloropropene Indeno[1,2,3-cd]pyrene Indeno[1,2,3-cd]pyrene Isodrin Isophorone

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (\$) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW)

Resource Conservation Recovery Program (S)

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Isophorone

Isosafrole

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Jennifer Jamison

Page 11 of 14

Isosafrole Methapyritene Methapyrilene Methyl methanesulfonate Methyl methanesulfonate Methyl parathion Methyl parathion Nachthalene Nachthalene Nitrobenzene Nitrobenzene Nitroquinoline-1-oxide n-Nitrosodiethylamine n-Nitrosodiethylamine n-Nitrosodimethylamine n-Nitrosodimethylamine n-Nitroso-di-n-butylamine n-Nitroso-di-n-butylamine n-Nitroso-di-n-propylamine n-Nitroso-di-n-propylamine n-Nitrosodiphenylamine n-Nitrosodiphenylamine n-Nitrosomethylethylamine n-Nitrosomorpholine n-Nitrosoploeridine n-Nitrosopiperidine n-Nitrosopyrrolidine n-Nitrosopyrrolidine o,o,o-Triethyl phosphorothicate o,o,o-Triethyl phosphorothioate o-Toluidine o-Toluidine Pentachlorobenzene Pentachlorobenzene Pentachloronitrobenzene Pentachloronitrobenzene Pentachlorophenol Pentachlorophenol Phenacetin Phenacetin Phenanthrene Phenanthrene Phenol Phenol Phorate Phorate Pronamide (Kerb) Pronamide (Kerb) Pyrene Pyrene Pyridina Pyridine Safrole Safrole Sulfotepp Thionazin (Zinophos) EPA 8310 Acenaphthene Acenaohthylene

Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (NPW) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (S)

Resource Conservation Recovery Program (S)

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Certificate Number: FOT Issue Date:

Anthracene

Benzo[a]anthracene

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Resource Conservation Recovery Program (NPW)

Page 12 of 14

Benzo[a]pyrene Resource Conservation Recovery Program (NPW) Benzo[b]fluoranthene Resource Conservation Recovery Program (NPW) Benzo(g,h,i]perylene Resource Conservation Recovery Program (NPW) Benzolklfluoranthene Resource Conservation Recovery Program (NPW) Chrysene Resource Conservation Recovery Program (NPW) Dibenz[a,h]anthracene Resource Conservation Recovery Program (NPW) Fluoranthene Resource Conservation Recovery Program (NPW) Fluorene Resource Conservation Recovery Program (NPW) Indeno[1,2,3-cd]pyrene Resource Conservation Recovery Program (NPW) Naphthalene Resource Conservation Recovery Program (NPW) Phenanthrene Resource Conservation Recovery Program (NPW) Pyrene Resource Conservation Recovery Program (NPW) EPA 8330 1,3,5-Trinitrobenzene (1,3,5-TNB) Resource Conservation Recovery Program (S) 1,3-Dinitrobenzene (1,3-DNB) Resource Conservation Recovery Program (S) 2,4,6-Trinitrotoluene (2,4,6-TNT) Resource Conservation Recovery Program (S) 2,4-Dinitrotoluene (2,4-DNT) Resource Conservation Recovery Program (S) 2,6-Dinitrotoluene (2,6-DNT) Resource Conservation Recovery Program (S) 2-Amino-4,6-dinitrotoluene (2-am-dnt) Resource Conservation Recovery Program (S) 2-Nitrotoluene Resource Conservation Recovery Program (S) 3-Nitrotoluene Resource Conservation Recovery Program (S) 4-Amino-2,6-dinitrotoluene (4-am-dnt) Resource Conservation Recovery Program (S) Resource Conservation Recovery Program (\$) HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine) Resource Conservation Recovery Program (S) Nitrobenzene Resource Conservation Recovery Program (S) Nitroglycerin Resource Conservation Recovery Program (S) Pentaerythritoltetranitrate Resource Conservation Recovery Program (S) RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine) Resource Conservation Recovery Program (S) Tetryl (methyl-2,4,6-trinitrophenylnitramine) Resource Conservation Recovery Program (S) EPA 9012B Total Cyanide Resource Conservation Recovery Program (NPW) Total Cyanide Resource Conservation Recovery Program (S) EPA 9034 Sulfide Resource Conservation Recovery Program (NPW) Sulfide Resource Conservation Recovery Program (S) **EPA 9045D** pΗ Resource Conservation Recovery Program (S) EPA 9056A Bromide Resource Conservation Recovery Program (NPW) Bromide Resource Conservation Recovery Program (S) Chloride Resource Conservation Recovery Program (NPW) Chloride Resource Conservation Recovery Program (\$) Fluoride Resource Conservation Recovery Program (NPW) Fluoride Resource Conservation Recovery Program (S) Nitrate as N Resource Conservation Recovery Program (NPW) Nitrate as N Resource Conservation Recovery Program (S) Nitrite as N Resource Conservation Recovery Program (NPW) Nitrite as N Resource Conservation Recovery Program (S) Sulfate Resource Conservation Recovery Program (NPW) Sulfate Resource Conservation Recovery Program (S) EPA 9060 Total Organic Carbon Resource Conservation Recovery Program (NPW) EPA 9066 **Total Phenolics** Resource Conservation Recovery Program (NPW) Total Phenolics Resource Conservation Recovery Program (S) EPA RSK-175 Ethane Resource Conservation Recovery Program (NPW) Ethene Resource Conservation Recovery Program (NPW) Methane Resource Conservation Recovery Program (NPW) SM 2320 B 20th ED

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2013033 5/13/2014

Expiration Date:

11/12/2014

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Page 13 of 14

Alkalinity as CaCO3 Alkalinity as CaCO3 SM 2320 B 21st ED Alkalinity as CaCO3 Alkalinity as CaCO3 SM 2340 B 20th ED Hardness SM 2340 B 21st ED Hardness SM 2540 B 20th ED Residue-total (TS) SM 2540 B 21st ED Residue-total (TS) SM 2540 C 20th ED Residue-filterable (TDS) Residue-filterable (TDS) SM 2540 C 21st ED Residue-filterable (TDS) Residue-filterable (TDS) SM 2540 D 20th ED Residue-nonfilterable (TSS) SM 2540 D 21st ED Residue-nonfilterable (TSS) SM 2540 F 20th ED Residue-settleable SM 2540 F 21st ED Residue-settleable SM 4500-CIT E 20th ED Chloride SM 4500-CI E 21st ED Chloride SM 4500-S2 F 20th ED

SM 4500-S2 F 21st ED Sulfide SM 5210 B 20th ED Biochemical oxygen demand Carbonaceous BOD, CBOD SM 5210 B 21st ED Biochemical oxygen demand Carbonaceous BOD, CBOD SM 5310 C 20th ED Total Organic Carbon Total Organic Carbon

Sulfide

Clean Water Program (NPW) Safe Drinking Water Program (DW)

Clean Water Program (NPW) Safe Drinking Water Program (DW)

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Clean Water Program (NPW) Safe Drinking Water Program (DW)

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Jennifer Jamison

Page 14 of 14



American Association for Laboratory Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

MICROBAC LABORATORIES, INC. OHIO VALLEY DIVISION

Marietta, OH

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 9th day of December 2013.

President & CEO

For the Accreditation Council

Certificate Number 2936.01

Valid to December 31, 2015

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

MICROBAC LABORATORIES, INC. OHIO VALLEY DIVISION 158 Starlite Drive Marietta, OH 45750

Leslie Bucina Phone: 740-373-4071 Email address: lbucina@microbac.com

ENVIRONMENTAL

Valid To: December 31, 2015 Certificate Number: 2936.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, LC/MS/MS, Ion Chromatography, Misc.-Electronic Probes (pH, O₂), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
<u>Metals</u>		
Aluminum	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	

(A2LA Cert No. 2936.01) 12/09/2013

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Page 1 of 61

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Antimony	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Arsenic	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Barium	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Beryllium	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Boron	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	211120011200100
	EPA 3015/6010C	
	EPA 3015A/6010C	
Cadmium	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051/0020 EPA 3051A/6020
	EPA 3005A/0010C EPA 3015/6010C	
		EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
~	EPA 3015A/6020A	
Calcium	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	
Chromium	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Cobalt	EPA 200.7	EPA 3051/6010B
Codair	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051A/0010B EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015/0010B EPA 3015A/6010B	EPA 3051A/6010C EPA 3051/6020
	EPA 3015A/0010B EPA 3005A/6010C	
		EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	O_{i} O_{i}

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
	EPA 3015A/6020A	
Copper	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	2111303114002011
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Iron	EPA 200.7	EPA 3051/6010B
11011	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051/6010C EPA 3051A/6010C
	EPA 3015A/0010B EPA 3005A/6010C	EFA 3031A/0010C
	EPA 3003A/0010C EPA 3015/6010C	
	EPA 3015/6010C EPA 3015A/6010C	
Lead	EPA 3013A/0010C	EPA 3051/6010B
Lead	EPA 200.7 EPA 200.8	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/0010B
	EPA 3003A 0010B EPA 3015/6010B	EPA 3051/6010C EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051A/0010C EPA 3051/6020
	EPA 3005A/6010C	EPA 3051/0020 EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/40020 EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	EFA 3031A/0020A
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015/6020A EPA 3015A/6020A	
Lithium	EPA 200.7	EPA 3051/6010B
Limum	EPA 3005A/6010B	EPA 3051/0010B EPA 3051A/6010B
	EPA 3005A/0010B	EPA 3051A/0010B EPA 3051/6010C
	EPA 3013/0010B EPA 3015A/6010B	
		EPA 3051A/6010C
	EPA 3005A/6010C EPA 3015/6010C	
Magnesium	EPA 3015A/6010C EPA 200.7	EDA 2051/6010D
iviaghesium		EPA 3051/6010B
	EPA 3005A/6010B EPA 3015/6010B	EPA 3051A/6010B EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Manganese	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Mercury	EPA 245.1	EPA 7471A
	EPA 7470A	EPA 7471B
Molybdenum	EPA 200.7	EPA 3051/6010B
14101y bacham	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	EI A 3031A/0010C
	EPA 3015/6010C	
	EPA 3015A/6010C	
Nickel	EPA 200.7	EPA 3051/6010B
TVICKCI	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 30517/0020 EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	LI A 3031A/0020A
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015/0020A EPA 3015A/6020A	
Phosphorus	EPA 200.7	EPA 3051/6010B
Filospilorus	EPA 200.7 EPA 3005A/6010B	EPA 3051/0010B EPA 3051A/6010B
	EPA 3003A 0010B EPA 3015/6010B	
	EPA 3015/6010B EPA 3015A/6010B	EPA 3051/6010C
	EPA 3013A/6010B EPA 3005A/6010C	EPA 3051A/6010C
	EPA 3003A/0010C EPA 3015/6010C	
Deteccione	EPA 3015A/6010C	EDA 2051/(010D
Potassium	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Selenium	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Silicon	EPA 200.7	***************************************
	EPA 3005A/6010B	
	EPA 3015/6010B	
	EPA 3015A/6010B	
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	
Silver	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	L171 50511 0 002011
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Sodium	EPA 200.7	EPA 3051/6010B
Sodium	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/40010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	LI A 3031A/0010C
	EPA 3015/6010C	
	EPA 3015A/6010C	
Strontium	EPA 3013A/0010C	EPA 3051/6010B
Strontium	EPA 3005A/6010B	EPA 3051/0010B EPA 3051A/6010B
	EPA 3003A/0010B EPA 3015/6010B	EPA 3051A/0010B EPA 3051/6010C
	EPA 3015/6010B EPA 3015A/6010B	EPA 3051/6010C EPA 3051A/6010C
	EPA 3013A/0010B EPA 3005A/6010C	LIA JUJIA/UUIUC
	EPA 3005A/6010C EPA 3015/6010C	
	EPA 3015/6010C EPA 3015A/6010C	
	EFA 3013A/0010C	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Thallium	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Tin	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	
Titanium	EPA 200.7	EPA 3051/6010B
	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051A/6010C
	EPA 3005A/6010C	
	EPA 3015/6010C	
	EPA 3015A/6010C	
Uranium	EPA 200.8	EPA 3051/6020
	EPA 3015/6020	EPA 3051A/6020
	EPA 3015A/6020	EPA 3051/6020A
	EPA 3015/6020A	EPA 3051A/6020A
	EPA 3015A/6020A	
Vanadium	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Zinc	EPA 200.7	EPA 3051/6010B
	EPA 200.8	EPA 3051A/6010B
	EPA 3005A/6010B	EPA 3051/6010C
	EPA 3015/6010B	EPA 3051A/6010C
	EPA 3015A/6010B	EPA 3051/6020
	EPA 3005A/6010C	EPA 3051A/6020
	EPA 3015/6010C	EPA 3051/6020A
	EPA 3015A/6010C	EPA 3051A/6020A
	EPA 3015/6020	
	EPA 3015A/6020	
	EPA 3015/6020A	
	EPA 3015A/6020A	
Zirconium	EPA 200.7	EPA 3051/6010B
Zircomum	EPA 3005A/6010B	EPA 3051A/6010B
	EPA 3015/6010B	EPA 3051/6010C
	EPA 3015A/6010B	EPA 3051/6010C EPA 3051A/6010C
	EPA 3005A/6010C	EFA 3031A/0010C
	EPA 3015/6010C	
	EPA 3015A/6010C	
Nutrients		
Ammonia (as N)	EPA 350.1	EPA 350.1
,	SM 4500-NH3 B-1997	SM 4500-NH3 B-1997
	SM 4500-NH3 G-1997	SM 4500-NH3 G-1997
Kjeldahl nitrogen	EPA 351.2	
Nitrate (as N)	EPA 300.0	EPA 9056
,	EPA 9056	EPA 9056A
	EPA 9056A	
	EPA 353.2	
Nitrate-nitrite (as N)	EPA 300.0	EPA 9056
,	EPA 9056	EPA 9056A
	EPA 9056A	
	EPA 353.2	
Nitrite (as N)	EPA 300.0	EPA 9056
()	EPA 9056	EPA 9056A
	EPA 9056A	
	EPA 354.1	
Orthophosphate (as P)	EPA 365.2	EPA 365.2
(us 1)	SM 4500-P E-1999	2111303.2
Total phosphorus	EPA 365.4	
<u>Demands</u>		
Biochemical	SM 5210 B-2001	
Oxygen demand	DDA 410 43 50D	
Chemical oxygen demand	EPA 410.4MOD	
m . 1	HACH 8000	
Total organic carbon	EPA 415.1	LLOYDKAHN
	EPA 9060A	
	SM5310 C-2000	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Wet Chemistry		
Alkalinity	EPA 310.1	1
	EPA 310.2	
	SM 2320 B-1997	
Bromide	EPA 300.0	EPA 9056
210	EPA 9056	EPA 9056A
	EPA 9056A	D111 703 011
Chloride	EPA 300.0	EPA 9056
	EPA 9056	EPA 9056A
	EPA 9056A	EPA 325.2
	EPA 325.2	SM 4500-CL E-1997
	SM 4500-CL E-1997	3W 4300-CE E-1997
Cyanide	SM 4500 CN-C,E-1999	EPA 9010C/9014
Cyainde	EPA 9010C/9014	EFA 9010C/9014
Amenable Cyanide	SM 4500 CN-G-1999	EPA 9010C/9014
Amenable Cyamide		EPA 9010C/9014
Fluoride	EPA 9010C/9014	EDA 200 0
riuoride	EPA 300.0	EPA 300.0
	EPA 9056	EPA 9056
	EPA 9056A	EPA 9056A
T.T.	SM 4500 F,C-1997	SM 4500 F,C-1997
pH	SM 4500-H ⁺ B-2000	EPA 9040C
0.11	EPA 9040C	EPA 9045D
Oil and Grease	EPA 1664A	EPA 1664A
Phenols	EPA 420.1	EPA 420.1
Total residue	EPA 160.3	
	SM 2540 B-1997	
Filterable residue	EPA 160.1	
	SM 2540 C-1997	
Nonfilterable residue	EPA 160.2	
	SM 2540 D-1997	
Sulfate	EPA 300.0	EPA 9056
	EPA 9056	EPA 9056A
	EPA 9056A	EPA 375.4
	EPA 375.4	SM 4500 SO4 E-1997
	SM 4500 SO4 E-1997	
Sulfide	EPA 376.1	EPA 9030B/9034
	SM 4500-S F-2000	
Flashpoint	EPA 1010A	EPA 1010A
Ferrous Iron	SM 3500-Fe B-1997	
Hexavalent chromium		
	SM 3500-Cr B-2009	SM 3500-Cr B -2009
	EPA 7196A	EPA3060A/7196A

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Purgeable Organics (Volatiles)		
Acetone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Acetonitrile	EPA 624 EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Acrolein	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Acrylonitrile	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Allyl chloride	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
T-amylmethylether	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Benzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromobenzene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromochloromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromodichloromethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromoform	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
Bromomethane	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
1,3-Butadiene	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
2-Butanone	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B
n-Butyl alcohol	EPA 624 EPA 5030B/8260B EPA 5030C/8260B	EPA 5035/8260B EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Tert-Butyl alcohol	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
n-Butylbenzene	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	D1113033110200B
Sec-Butylbenzene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	B1113033110200B
Tert-Butylbenzene	EPA 624	EPA 5035/8260B
2 CAN DUILY 10 CAMERA	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	E171 30337 V 0200B
Carbon disulfide	EPA 624	EPA 5035/8260B
Caroon distinde	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030B/8200B EPA 5030C/8260B	EPA 3033A/8200B
Carbon tetrachloride		EDA 5025/9260D
Carbon tetracmonde	EPA 624 EPA 5030B/8260B	EPA 5035/8260B
		EPA 5035A/8260B
Chlorobenzene	EPA 5030C/8260B	TD + 5005/00 (0D
Cniorobenzene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
01.1	EPA 5030C/8260B	
Chloroethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	P COS HE HAVE HAVE
2-Chloroethyl vinyl ether	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Chloroform	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Chloroprene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1-Chlorohexane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Chloromethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
2-Chlorotoluene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
4-Chlorotoluene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Cyclohexane	EPA 624	EPA 5035/8260B
o joronomino	EPA 5030B/8260B	EPA 5035/8260B EPA 5035A/8260B
	EPA 5030B/8200B EPA 5030C/8260B	EI A 3033A 0200B
	LI A 30300/0200D	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Cyclohexanone	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Dibromochloromethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Dibromofluoromethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	140000000000000000000000000000000000000
1,2-Dibromo-3-chloropropane	EPA 624	EPA 5035/8260B
(DBCP)	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
	EPA 8011	
Dibromomethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,2Dibromomethane (EDB)	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
	EPA 8011	
1,2-Dichlorobenzene	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,3-Dichlorobenzene	EPA 624	EPA 5035/8260B
,-	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,4-Dichlorobenzene	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	27110 00012 02002
Trans-1,4-Dichloro-2-butene	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Dichlorodifluoromethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	EXXX 0 0 0 0 1 2 0 2 0 0 0 0
1,1-Dichloroethane	EPA 624	EPA 5035/8260B
-,- =	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	211100301202002
1,2-Dichloroethane	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	244100001202002
1,1-Dichloroethene	EPA 624	EPA 5035/8260B
2,1 2 .0	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	211130331102002
cis-1,2-Dichloroethene	EPA 624	EPA 5035/8260B
,- 2 111101000110110	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
trans-1,2-Dichloroethene	EPA 624	EPA 5035/8260B
1,2 2.10110110110110	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
	Li A 3030C/0200D	Page 12 of

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
1,2-Dichloropropane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,3-Dichloropropane	EPA 624	EPA 5035/8260B
, I I I	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	D111 30331 4 0200D
2,2-Dichloropropane	EPA 624	EPA 5035/8260B
2,2 Biemoropropane	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L1 11 303374 0200B
1,1-Dichloropropene	EPA 624	EPA 5035/8260B
1,1-Biemoropropene	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	EI A 3033A/8200B
ois 1.2 Dishlarannanana		EDA 5025/0260D
cis-1,3-Dichloropropene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
12 D' 11	EPA 5030C/8260B	77
trans-1,3-Dichloropropene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Diethyl ether	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Di-isopropyl ether	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Dimethyldisulfide	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Dimethyl sulfide	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,4-Dioxane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Ethyl acetate	EPA 624	EPA 5035/8260B
,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Ethyl -t-butyl ether	EPA 624	EPA 5035/8260B
y = - 0 - 2 0 - 0 - 0 - 0 - 0 - 0 - 0 -	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Ethyl methacrylate	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	111130331102001
Ethyl benzene	EPA 624	EPA 5035/8260B
Lary i compone	EPA 5030B/8260B	EPA 5035/8200B EPA 5035A/8260B
	EPA 5030D/8200B EPA 5030C/8260B	LI A 3033A 0200D
	LI A 3030C/0200D	

	Nonpotable Water (1)	Solid and Chemical Materials (2)
Gas Range Organics (GRO)	EPA 5030B/8015B	EPA 5035/8015B
	EPA 5030C/8015B	EPA 5035/8015C
	EPA 5030B/8015C	EPA 5035/8015D
	EPA 5030C/8015C	EPA 5035A/8015B
	EPA 5030B/8015D	EPA 5035A/8015C
	EPA 5030C/8015D	EPA 5035A/8015D
	OK-GRO	OK-GRO
2-Hexanone		
2-nexalione	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	-
Hexachlorobutadiene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Isoprene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Isopropylbenzene	EPA 624	EPA 5035/8260B
1 13	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,4-Isopropyltoluene	EPA 624	EPA 5035/8260B
i, i loopropymoraome	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	LI A 3033A 6200B
Iodomethane	EPA 624	EPA 5035/8260B
lodomemane	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	El A 3033A 6200D
Isobutyl alcohol	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	EFA 3033A/ 8200B
Isopropyl alcohol	EPA 624	EPA 5035/8260B
isopropyr accords		
	EPA 5030B/8260B	EPA 5035A/8260B
N. 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	EPA 5030C/8260B	WD
Methacrylonitrile	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Methyl acetate	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Methylcyclohexane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Methyl methacrylate	EPA 624	EPA 5035/8260B
-	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Alpha-Methylstyrene	EPA 624	EPA 5035/8260B
1	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	DX113033110200D
	EPA 624	EPA 5035/8260B
Methyl tert-hutyl ether		
Methyl tert-butyl ether		
Methyl tert-butyl ether	EPA 5030B/8260B EPA 5030C/8260B	EPA 5035A/8260B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Methylene chloride	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
4-Methyl-2-pentanone	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Naphthalene	EPA 624	EPA 5035/8260B
•	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	BATTE OBETT OF OB
2-Nitropropane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L111 3033A 0200B
n-Propylbenzene	EPA 624	EPA 5035/8260B
11-1 Topy to enzene	EPA 5030B/8260B	EPA 5035/8200B EPA 5035A/8260B
	EPA 5030B/8200B EPA 5030C/8260B	EFA 3033A/8200B
Propionitrile	EPA 3030C/8200B	EPA 5035/8260B
торюшине	EPA 624 EPA 5030B/8260B	EPA 5035/8260B EPA 5035A/8260B
	EPA 5030B/8200B EPA 5030C/8260B	EPA 3033A/8200B
Styrene		EDA 5025/02C0D
Styrene	EPA 624 EPA 5030B/8260B	EPA 5035/8260B
		EPA 5035A/8260B
1 1 1 2 Total all and others	EPA 5030C/8260B	EDA 5025/0260D
1,1,1,2-Tetrachloroethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
1100 T / 11	EPA 5030C/8260B	TD 1
1,1,2,2-Tetrachloroethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Tetrachloroethene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Tetrahydrofuran	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Toluene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,1,1-Trichloroethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,1,2-Trichloroethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Trichloroethene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
Trichlorofluoromethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,2,3-Trichlorobenzene	EPA 624	EPA 5035/8260B
	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,2,3-Trichloropropane	EPA 624	EPA 5035/8260B
• •	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	
1,2,4-Trichlorobenzene	EPA 624	EPA 5035/8260B
, ,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	21100001302002
1,2,4-Trimethylbenzene	EPA 624	EPA 5035/8260B
-, -, ,	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	E1712033110200B
1,3,5-Trimethylbenzene	EPA 624	EPA 5035/8260B
1,5,6 111116111,1861116116	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	E1713033740200B
Vinyl acetate	EPA 624	EPA 5035/8260B
· my r decide	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L171 30337 0 0200 D
Vinyl chloride	EPA 624	EPA 5035/8260B
· myr omorido	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L171 30337 0 0 200 D
Xylenes, total	EPA 624	EPA 5035/8260B
Try tottos, total	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L171 30337 0 0200D
1,2-Xylene	EPA 624	EPA 5035/8260B
1,2 11,10110	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L1 /1 3033/1 0200D
1,3-Xylene	EPA 624	EPA 5035/8260B
1,5 Try tone	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	L171 303374 6200D
1,4-Xylene	EPA 624	EPA 5035/8260B
1, 1 Try tene	EPA 5030B/8260B	EPA 5035A/8260B
	EPA 5030C/8260B	LI A 3033A 6200B
	E1 A 3030C/8200B	_
Headspace Organics		
Carbon dioxide	EPA 5021/RSK175	
Methane	EPA 5021/RSK175	
Ethane	EPA 5021/RSK175	
Ethene	EPA 5021/RSK175	
Propane	EPA 5021/RSK175	
Acetylene	EPA 5021/RSK175	
1 tooty telle	LI A 30/21/RSX1/3	

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Acenaphthene	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Acenaphthylene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
		EFA 3340/02/0D-3HVI

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Acetophenone	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	D1713320070270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550B/8270D EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
2 4 1 : 0	TDD 4 62.5	EPA 3546/8270D
2-Acetylaminofluorene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
4-Aminobiphenyl	EPA 625	EPA 3545/8270C
-	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Aniline	EPA 625	EPA 3545/8270C
Ailiiiiic	EPA 023 EPA 3510C/8270C	
		EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Anthracene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3510C/8270C-SIM	EPA 3545A/8270D
	EPA 3520C/8270C-SIM EPA 3510C/8270D-SIM	
	EPA 3510C/8270D-SIM EPA 3520C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/82/0D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Aramite	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	22.1.55200.02102	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Benzidine	FDA 625	
Belizidille	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Benzoic acid	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Benzo (a) anthracene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Benzo (b) fluoranthene	EPA 625	EPA 3545/8270C
、 ,	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
	E1 11 3320 C/02 / 0D-5HVI	EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Benzo (k) fluoranthene	EPA 625	EPA 3545/8270C
Belizo (k) Huorantinene	EPA 3510C/8270C	EPA 3545/8270C EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3510C/8270D EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3510C/8270C-SIM	EPA 3545/8270D EPA 3545A/8270D
	EPA 3520C/8270C-SIM	EPA 3550B/8270D
	EPA 3510C/8270D-SIM	EPA 3550C/8270D
	EFA 3320C/8270D-311VI	EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Benzo (g,h,i) perylene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
	LI A 3320C/8270D-311VI	EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3546/8270D EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Benzo (a) pyrene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
·		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Benzyl alcohol	EPA 625	EPA 3545/8270C
-	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	211133200,02702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Benzaldehyde	EPA 625	
Benzaidenyde		EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Biphenyl	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Bis(2-chloroethoxy) methane	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		LIXI JUTUI UZ I UL

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Bis (2-chloroethyl) ether	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E171 3320 C/02 / 0B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
7		EPA 3546/8270D
Bis(2-chloroisopropyl) ether	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Bis (2-ethylhexyl) phthalate	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
4-Bromophenylphenylether	EPA 625	EPA 3545/8270C
4-Bromophenyiphenyiemer	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3510C/8270D EPA 3520C/8270D	EPA 3580A/8270C
	EFA 3320C/82/0D	EPA 3580A/8270C EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Butyl benzyl phthalate	EPA 625	EPA 3545/8270C
zaty: compy promine	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	211100200.02702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Caprolactam	EPA 625	EPA 3545/8270C
Capiolaciam	EPA 3510C/8270C	EPA 3545/8270C EPA 3545A/8270C
	EPA 3510C/8270C EPA 3520C/8270C	EPA 3550B/8270C
		EPA 3550C/8270C
	EPA 3510C/8270D	
	EPA 3520C/8270D	EPA 3580A/8270C EPA 3545/8270D
		EPA 3545/8270D EPA 3545A/8270D
		EPA 3545A/8270D EPA 3550B/8270D
		EPA 3550B/8270D EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
Carbazole	FDA 625	EPA 3546/8270D
Carbazole	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
4-Chloroaniline		EPA 3580A/8270D
		EPA 3546/8270C
	77.4	EPA 3546/8270D
	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Chlorobenzilate	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	211100200702702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
4 (1) 2 (1) 1	ED 4 (05	EPA 3546/8270D
4-Chloro-3-methylphenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1-Chloronaphthalene	EPA 625	EPA 3545/8270C
1	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	211133200702702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2-Chloronaphthalene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2-Chlorophenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	221,202,02,02	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
4-Chlorophenylphenyl ether	EPA 625	EPA 3546/8270D
4-Chlorophenyiphenyi ether		
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Chrysene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
•		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
		DI IX 3340/02/019-31141

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Cresols	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Diallate	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Dibenzo (a,c) anthracene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Dibenzo (a,h) anthracene	EPA 625	EPA 3545/8270C
Zionizo (u,ii) umizueene	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
	LI A 3320C/8270D-31W	EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Dibenzofuran	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1,2-Dichlorobenzene	EPA 625	EPA 3545/8270C
,, - 2 10,110 10 00 1111 1110	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	LI A 3320C/02/0D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
1,3-Dichlorobenzene	EPA 625	EPA 3545/8270C
,, =	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E111 33200,0270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1,4-Dichlorobenzene	TDA 625	
1,4-Dicinorobenzene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
3,3'-Dichlorobenzidine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2,4-Dichlorophenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		LI A 3370/02/0D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2,6-Dichlorophenol	EPA 625	EPA 3545/8270C
2,0 Bromorophonor	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E1 11 3320 C/02 70 D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Diethyl phthalate	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Dimethoate	EPA 625	EPA 3545/8270C
B miletioare	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E1 A 3320C/0270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
4-Dimethylaminoazobenzene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
7,12-Dimethylbenz(a)anthracene	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	L171 3320C/0270B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
3,3'-Dimethylbenzidine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Alpha-,alpha-	EPA 625	EPA 3545/8270C
Dimethylphenethylamine	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	LI A 3320C/0270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2,4-Dimethylphenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Nonpotable Water (1) EPA 625 EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D EPA 3520C/8270D	EPA 3545/8270C EPA 3545A/8270C EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
EPA 3520C/8270C EPA 3510C/8270D	EPA 3550B/8270C EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
EPA 3520C/8270C EPA 3510C/8270D	EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
EPA 3510C/8270D	EPA 3550C/8270C EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
	EPA 3580A/8270C EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
BX 11 30 20 0.10 2 10 2	EPA 3545/8270D EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
	EPA 3545A/8270D EPA 3550B/8270D EPA 3550C/8270D
	EPA 3550B/8270D EPA 3550C/8270D
	EPA 3550C/8270D
	EPA 3580A/8270D
	EPA 3546/8270C
	EPA 3546/8270D
EDA 625	EPA 3545/8270C
1	EPA 3545A/8270C
	EPA 3550B/8270C
	EPA 3550C/8270C
EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3545/8270D
	EPA 3545A/8270D
	EPA 3550B/8270D
	EPA 3550C/8270D
	EPA 3580A/8270D
	EPA 3546/8270C
	EPA 3546/8270D
	EPA 3545/8270C
	EPA 3545A/8270C
EPA 3520C/8270C	EPA 3550B/8270C
EPA 3510C/8270D	EPA 3550C/8270C
EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3545/8270D
	EPA 3545A/8270D
	EPA 3550B/8270D
	EPA 3550C/8270D
	EPA 3580A/8270D
	EPA 3546/8270C
_	EPA 3546/8270D
EPA 625	EPA 3545/8270C
EPA 3510C/8270C	EPA 3545A/8270C
EPA 3520C/8270C	EPA 3550B/8270C
EPA 3510C/8270D	EPA 3550C/8270C
EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3545/8270D
	EPA 3545A/8270D
	EPA 3550B/8270D
	EPA 3550C/8270D
	EPA 3580A/8270D
	EPA 3546/8270C
	EPA 3546/8270D
	EPA 3510C/8270C EPA 3520C/8270C EPA 3510C/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2,4-Dinitrotoluene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2,6-Dinitrotoluene	EPA 625	EPA 3545/8270C
,	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1,4-Dioxane	EPA 3510C/8270C	EPA 3545/8270C
	EPA 3520C/8270C	EPA 3545A/8270C
	EPA 3510C/8270D	EPA 3550B/8270C
	EPA 3520C/8270D	EPA 3550C/8270C
	EPA 3520C/8270C-SIM	EPA 3580A/8270C
	EPA 3520C/8270D-SIM	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Diphenylamine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1,2-Diphenylhydrazine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Disulfoton	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
DRO/ORO	EPA 3510C/8015B	EPA 3545/8015B
	EPA 3510C/8015C	EPA 3545A/8015B
	EPA 3510C/8015D	EPA 3550B/8015B
	OK-DRO	EPA 3550C/8015B
		EPA 3545/8015C
		EPA 3545A/8015C
		EPA 3550B/8015C
		EPA 3550C/8015C
		EPA 3545/8015D
		EPA 3545A/8015D
		EPA 3550B/8015D
		EPA 3550C/8015D
		EPA 3546/8015B
		EPA 3546/8015C
		OK-DRO
Ethyl methanesulfonate	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Ethyl parathion	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Famphur	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Fluoroanthene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Fluorene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
	E1 A 3320C/0270D-3111	EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Hexachlorobenzene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Hexachlorobutadiene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	LI A 3320C/02/0D	EPA 3545/8270D
		EPA 3545/8270D EPA 3545A/8270D
		EPA 3545A/8270D EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Hexachlorocyclopentadiene	EPA 625	EPA 3545/8270C
J 1	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E1713320C/0270B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Y7 11 11	ED 4 (07	
Hexachloroethane	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Hexachlorophene	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Hexachloropropene	EPA 625	EPA 3545/8270C
Tiexacinoropropene	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3510C/8270D EPA 3520C/8270D	EPA 3580A/8270C
	EFA 3320C/02/0D	EPA 3545/8270D
		EPA 3545A/8270D EPA 3545A/8270D
		EPA 3543A/8270D EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Indeno (1,2,3-cd) pyrene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3520C/8270C-SIM EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3510C/8270D-SIM	EPA 3550C/8270D
	EPA 3320C/82/0D-81101	EPA 3530C/8270D EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Isodrin	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E111 3320 C/0210D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
T 1	ED 1 (2)	
Isophorone	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Isosafrole	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Kepone	EPA 625	EPA 3545/8270C
Tepone	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E1 A 3320C/8270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Methapyrilene	EPA 625	EPA 3545/8270C
Wiethapythene	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3510C/8270C	EPA 3550B/8270C
	EPA 3520C/8270C EPA 3510C/8270D	EPA 3550B/8270C EPA 3550C/8270C
	EPA 3510C/8270D EPA 3520C/8270D	EPA 3550C/8270C EPA 3580A/8270C
	EFA 3320C/8270D	EPA 3545/8270D
		EPA 3545/8270D EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
3-Methylcholanthrene	EPA 625	EPA 3545/8270C
3-Methylcholanthene	EPA 023 EPA 3510C/8270C	EPA 3545/8270C EPA 3545A/8270C
	EPA 3510C/8270C EPA 3520C/8270C	EPA 3545A/8270C EPA 3550B/8270C
		EPA 3550B/8270C EPA 3550C/8270C
	EPA 3510C/8270D	EPA 3530C/8270C EPA 3580A/8270C
	EPA 3520C/8270D	EPA 3580A/8270C EPA 3545/8270D
		EPA 3545/8270D EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2-Methyl-4,6-dinitrophenol	EPA 625	EPA 3545/8270C
_	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	2.7730200,02702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Methyl methanesulfonate	EPA 625	EPA 3545/8270C
Methyl methanesunonate	EPA 323 EPA 3510C/8270C	EPA 3545/8270C EPA 3545A/8270C
		EPA 3550B/8270C
	EPA 3520C/8270C	
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1-Methylnaphthalene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
		LI A 3340/02/0D-01/1

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2-Methylnaphthalene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Methyl parathion	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Naphthalene	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3520C/8270C-SIM EPA 3510C/8270D-SIM	EPA 3550B/8270D
	I	
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
1,4-Naphthoquinone	EPA 625	EPA 3545/8270C
i, i i apinioquiione	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3510C/8270D EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3320C/8270D	
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1-Naphthylamine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
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Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
2-Naphthylamine	EPA 625	EPA 3545/8270C
1 ,	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E111 3320 C/02 / 0B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2 NT:	ED 4 (25	
2-Nitroaniline	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
3-Nitroaniline	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
4-Nitroaniline	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
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Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Nitrobenzene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	D11133200/0270B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
	777 . 605	EPA 3546/8270D
5-Nitro-o-toluidine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2-Nitrophenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E11133200/02/02	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
4 3 77 1 1	EDA (25	EPA 3545/8270C
4-Nitrophenol	EPA 625	
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Nitroquinoline-1-oxide	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E1 A 5520C/6270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3530C/8270D EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
n-Nitrosodiethylamine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
n-Nitrosodimethylamine	EPA 625	EPA 3545/8270C
, and the second second	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	211135200,02102	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
NT'A A' lasted a	EDA (25	
n-Nitroso-di-n-butylamine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
n-Nitrosodi-n-propylamine	EPA 625	EPA 3545/8270C
1 12	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E11135200,0270B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
NT1. 11 1 1	TD 1 605	
n-Nitrosodiphenylamine	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
n-Nitrosomorpholine	EPA 625	EPA 3545/8270C
-	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
n-Nitrosopiperidine	EPA 625	EPA 3545/8270C
ii i iii osopipeiidiie	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	LIA 33200/02/00	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580C/8270D EPA 3580A/8270D
		EPA 3546/8270D
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
n-Nitrosopyrrolidine	EPA 625	EPA 3545/8270C
•	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	22.2.50.20.67.027.02	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Pentachlorobenzene	EPA 625	EPA 3545/8270C
1 chtachiologenzene	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3510C/8270D	EPA 3580A/8270C
	El A 3320C/8270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Pentachloroethane	EPA 625	EPA 3545/8270C
1 Chtachiol Octhane	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E111 33200/02/0B	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Pentachloronitobenzene	EPA 625	EPA 3545/8270C
1 Chtachiorolintoochizene	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	Li A 3320C/02/0D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270D EPA 3546/8270C
		EPA 3546/8270D
		EFA 3340/02/0D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Pentachlorophenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Perylene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Phenacetin	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Phenanthrene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
	B11133200,02702 32.12	EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Phenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1,4-Phenylenediamine	EPA 625	EPA 3545/8270C
, ,	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
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Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Phorate	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2-Picoline	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Pronamide	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Pyrene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	EPA 3510C/8270C-SIM	EPA 3545/8270D
	EPA 3520C/8270C-SIM	EPA 3545A/8270D
	EPA 3510C/8270D-SIM	EPA 3550B/8270D
	EPA 3520C/8270D-SIM	EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		EPA 3545/8270C-SIM
		EPA 3545A/8270C-SIM
		EPA 3550B/8270C-SIM
		EPA 3550C/8270C-SIM
		EPA 3580A/8270C-SIM
		EPA 3545/8270D-SIM
		EPA 3545A/8270D-SIM
		EPA 3550B/8270D-SIM
		EPA 3550C/8270D-SIM
		EPA 3580A/8270D-SIM
		EPA 3546/8270C-SIM
		EPA 3546/8270D-SIM
Pyridine	EPA 625	EPA 3545/8270C
1 yrame	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	211133200,02702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
Safrole	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
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Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Sulfotepp	EPA 625	EPA 3545/8270C
* *	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	221123233732732	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1.2.4.5 Tetrachlershammen	EPA 625	EPA 3545/8270C
1,2,4,5-Tetrachlorobenzene		EPA 3545/8270C EPA 3545A/8270C
	EPA 3510C/8270C	EPA 3545A/8270C EPA 3550B/8270C
	EPA 3520C/8270C	EPA 3550C/8270C
	EPA 3510C/8270D	-·· · · - · ·
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2,3,4,6-Tetrachlorophenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
o,o,o-Triethyl phosphorothioate	EPA 625	EPA 3545/8270C
• • •	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D

Peter Mbrye

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Thionazin	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	B111 3320 0702 702	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
1047	ED 1 (25	
1,2,4-Trichlorobenzene	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2,4,5-Trichlorophenol	EPA 625	EPA 3545/8270C
	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
2,4,6-Trichlorophenol	EPA 625	EPA 3545/8270C
, ,	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
		EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270C
		EPA 3546/8270D
		LI A JUTO/02 / OD

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
O-Toluidine	EPA 625	EPA 3545/8270C
o romane	EPA 3510C/8270C	EPA 3545A/8270C
	EPA 3520C/8270C	EPA 3550B/8270C
	EPA 3510C/8270D	EPA 3550C/8270C
	EPA 3520C/8270D	EPA 3580A/8270C
	E1713320C/0270D	EPA 3545/8270D
		EPA 3545A/8270D
		EPA 3550B/8270D
		EPA 3550C/8270D
		EPA 3580A/8270D
		EPA 3546/8270D EPA 3546/8270C
		EPA 3546/8270D
		EFA 3340/02/0D
Pesticides/Herbicides/PCBs		
Aldrin	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
alpha-BHC	EPA 608	EPA 3550B/8081A
•	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
beta-BHC	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
delta-BHC	EPA 608	EPA 3550B/8081A
dena Bire	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
	211130100,00012	EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
gamma-BHC	EPA 608	EPA 3550B/8081A
gaillilla-DifC	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
	El A 3310C/8081B	EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Chlordane (technical)	EPA 608	EPA 3550B/8081A
Chordane (rechinear)	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081A EPA 3510C/8081B	EPA 3580A/8081A
	EFA 3310C/0001B	EPA 3550B/8081B
		EPA 3550E/8081B EPA 3550C/8081B
		EPA 3580A/8081B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
alpha-chlordane	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
gamma-chlordane	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
4,4'-DDD	EPA 608	EPA 3550B/8081A
,	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
4,4'-DDE	EPA 608	EPA 3550B/8081A
,,,	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
4,4',-DDT	EPA 608	EPA 3550B/8081A
, ,	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Dieldrin	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Endosulfan I	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Endosulfan II	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
Endonsulfan sulfate	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Endrin	EPA 608	EPA 3550B/8081A
	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Endrin aldehyde	EPA 608	EPA 3550B/8081A
•	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Endrin ketone	EPA 3510C/8081A	EPA 3550B/8081A
	EPA 3510C/8081B	EPA 3550C/8081A
		EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Heptachlor	EPA 608	EPA 3550B/8081A
1	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Heptachlor epoxide	EPA 608	EPA 3550B/8081A
*	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Methoxychlor	EPA 3510C/8081A	EPA 3550B/8081A
•	EPA 3510C/8081B	EPA 3550C/8081A
		EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B
Toxaphene	EPA 608	EPA 3550B/8081A
*	EPA 3510C/8081A	EPA 3550C/8081A
	EPA 3510C/8081B	EPA 3580A/8081A
		EPA 3550B/8081B
		EPA 3550C/8081B
		EPA 3580A/8081B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
PCB-1016 (Aroclor)	EPA 608	EPA 3550B/8082
	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
		EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A
		EPA 3546/8082
		EPA 3546/8082A
PCB-1221	EPA 608	EPA 3550B/8082
100 1221	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
	E1 A 3310C/0002A	EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A EPA 3580A/8082A
		EPA 3546/8082
DCD 1030	TD 4 600	EPA 3546/8082A
PCB-1232	EPA 608	EPA 3550B/8082
	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
		EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A
		EPA 3546/8082
		EPA 3546/8082A
PCB-1242	EPA 608	EPA 3550B/8082
	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
		EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A
		EPA 3546/8082
		EPA 3546/8082A
PCB-1248	EPA 608	EPA 3550B/8082
	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
		EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A
		EPA 3546/8082
		EPA 3546/8082A
PCB-1254	EPA 608	EPA 3550B/8082
	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
		EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A
		EPA 3546/8082
		EPA 3546/8082A

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
PCB-1260	EPA 608	EPA 3550B/8082
	EPA 3510C/8082	EPA 3550C/8082
	EPA 3510C/8082A	EPA 3580A/8082
		EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3580A/8082A
		EPA 3546/8082
		EPA 3546/8082A
PCB-1262	EPA 3510C/8082	EPA 3550B/8082
102 1202	EPA 3510C/8082A	EPA 3550C/8082
	211130100,000211	EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3546/8082
		EPA 3546/8082A
PCB-1268	EPA 3510C/8082	EPA 3550B/8082
1 CB-1200	EPA 3510C/8082A	EPA 3550C/8082
	LI A 3310C/8082/1	EPA 3550B/8082A
		EPA 3550C/8082A
		EPA 3546/8082
		EPA 3546/8082A
2,4-D	EPA 8151A	EPA 8151A
Dalapon	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	EPA 8151A
Dicamba	EPA 8151A	EPA 8151A
Dichloroprop	EPA 8151A	EPA 8151A
Dinoseb	EPA 8151A	EPA 8151A
MCPA	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	EPA 8151A
		EPA 8151A
Pentachlorophenol	EPA 8151A	EPA 8151A EPA 8151A
2,4,5-T	EPA 8151A	
2,4,5-TP	EPA 8151A	EPA 8151A
HPLC		
1,3,5-Trinitrobenzene	EPA 3535A/8330A	EPA 8330A
1,5,5-11111110001120110	EPA 3535A/8330B	EPA 8330B
1,3-Dinitrobenzene	EPA 3535A/8330A	EPA 8330A
1,3-Dillitiobelizette	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330B
2,4,6-Trinitrotoluene	EPA 3535A/8330B	EPA 8330A
2,4,6-1 rimitroloidene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330B
2,4-Dinitrotoluene	EPA 3535A/8330B EPA 3535A/8330A	EPA 8330A
2,4-Dimirotoluelle	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330B
2.6 Dinitratalyana		EPA 8330A
2,6-Dinitrotoluene	EPA 3535A/8330A EPA 3535A/8330B	EPA 8330A EPA 8330B
2 Amino 4.6 digitantalyana		EPA 8330A
2-Amino-4,6-dinitrotoluene	EPA 3535A/8330A	EPA 8330A EPA 8330B
2 Nitrodalisana	EPA 3535A/8330B	
2-Nitrotoluene	EPA 3535A/8330A	EPA 8330A
2.814 -4-1	EPA 3535A/8330B	EPA 8330B
3-Nitrotoluene	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B

Parameter/Analyte	Nonpotable Water (1)	Solid and Chemical Materials (2)
4-Amino-2,6-dinitrotoluene	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B
4-Nitrotoluene	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B
Nitrobenzene	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B
Nitroglycerin	EPA 3535A/8330A	EPA 8330A
3-7	EPA 3535A/8330B	EPA 8330B
HMX	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B
PETN	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B
RDX	EPA 3535A/8330A	EPA 8330A
	EPA 3535A/8330B	EPA 8330B
Tetryl	EPA 3535A/8330A	EPA 8330A
20071	EPA 3535A/8330B	EPA 8330B
Nitroglycerin	EPA 3535A/8330A	EPA 8330A
Titloglycom	EPA 3535A/8330B	EPA 8330B
Formaldehyde	EPA 8315A	EPA 8315A
Acetic acid	830MBA	
Butyric acid	830MBA	
Lactic acid	830MBA	
Propionic acid	830MBA	
Pyruvic acid	830MBA	
Hazardous Waste Characteristics Corrosivity	EPA 9040C	EPA 9040C
Corrosivity	LI A 9040C	EPA 9045D
Ignitibility	EPA 1010A	EPA 1010A
Reactive Cyanide	EPA SW 846 Ch 7 7.3.3.2-1996	EPA SW 846 Ch 7 7.3.3.2-1996
Reactive Sulfide	EPA SW 846 Ch 7 7.3.4.2-1996	EPA SW 846 Ch 7 7.3.4.2-1996
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311
Clean-up		
	EPA 3620B	EPA 3620B
_	EPA 3665A	EPA 3665A
	EPA 3630C	EPA 3630C
	EPA 3660B	EPA 3660B
I CMCMC		
LC/MS/MS Perchlorate	EPA 6850	EPA 6850

⁽¹⁾ Method List includes Clean Water Act and RCRA water parameters.(2) Method List includes RCRA parameters only.(A2LA Cert No. 2936.01) 12/09/2013

APPENDIX I

RESPONSE TO REGULATORY COMMENTS

RESPONSE TO MEDEP COMMENTS DATED SEPTEMBER 8, 2014
DRAFT SAMPLING AND ANALYSIS PLAN
SOIL/SEDIMENT/SURFACE WATER REMEDIAL INVESTIGATION OF QUARRY
AREA, DATED JULY 2014
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

Note that where the comment response provides revised text, text additions are shown in bold italics, and deleted text is shown as strikethrough.

General Comments

1. Comment: MEDEP has revised its electronic data deliverable format slightly and is now requiring the quality control data be submitted along with the sample data. The **MEDEP** associated codes and template are the website at http://www.maine/gov/dep/maps-data/egad/index.html. This information has already been sent to Maine certified labs that submit data to the Department, and Katahdin is familiar with this format. Please also submit the laboratory report associated with the data, either as an appendix on CD or as an electronic download when the EDD is submitted. This information will support review of the data validation and avoids unnecessary comments on the sample analysis.

Although groundwater sampling may not take place during this field event, please include a round of water levels while staff is mobilized to compare to the previous late season data.

Response: The comment concerning the MEDEP EDD is noted and the new format will be followed. The laboratory report(s) will also be submitted to MEDEP along with the EDD.

Concerning water level measurements, a round of groundwater levels will be collected in the Spring of 2015, concurrent with the additional round of groundwater sampling requested in Comment #11.

Specific Comments

2. <u>Comment</u>: Worksheet 3: The phone contact for Chris Evans is now 207-441-5181, please revise the table.

Response: Worksheet #3 and Worksheet #5 have been revised.

3. <u>Comment</u>: Worksheet 10, Hydrogeology and Appendix C Tech Memo Groundwater Report Hydrology/Hydrogeology: The bedrock seepage velocity is listed as 110 feet per day, the units need to be revised to feet per year.

<u>Response:</u> Worksheet #10 and the Tech Memo Groundwater Report have been corrected to indicate that the bedrock seepage velocity is 110 feet per year.

4. <u>Comment</u>: Worksheet 11, "What are the project action limits?": Based on review of the DoD Quality Systems Manual v.4.2, the two bullets must be revised. Concentrations less than the detection limit (DL) are typically classified as non-detect and assigned a value at the limit of detection (LOD). Concentrations between the DL and the limit of quantitation (LOQ) are assigned a "J" flag. Please revise as needed.

Response: The text has been revised per the comment,

- "All concentrations less than Limits of Detection (LODs) detection limits (DLs) will be classified as non-detects and will be reported at the Limits of Detection (LODs) as detection limit (DL) values with "U" qualifiers.
- Concentrations between LOQs and DLs LODs will be reported as estimated values with "J" qualifiers."
- 5. <u>Comment</u>: Worksheet 11, "What will the data be used for?", page 44: The background bedrock groundwater data are based on two well pairs located in close proximity to on another, and screened in the Cape Elizabeth Formation. As all the site wells are in various members of the Cushing formation elimination of any constituents due to background will require evaluations of whether there are differences in groundwater quality between the two formations. MEDEP will evaluate whether any other data may be available, and is interested in whether non-site related inorganic may indicate if there is similar groundwater chemistry in the two formations.

The data from Coffins Ice Pond have been discussed at length in previous document reviews, use of that data for sediment background comparison has not been accepted, due to the unusually elevated concentrations of multiple compounds.

Response: The difference in the formations in which the Quarry bedrock wells are screened versus the background bedrock wells is not considered to be a significant issue in screening of the groundwater data. Chemically, concentrations of metals at the Quarry are comparable to those detected in the bedrock wells. Mineralogically, the Cape Elizabeth and Cushing formations are similar, principally plagioclasequartz-mica rocks, with the exception of the band of amphibolite running through the Cushing formation at the Quarry. Geochemically, the groundwater from the Quarry bedrock wells is also similar, with values for specific conductivity, dissolved oxygen and oxidation-reduction potential (ORP) being similar, with the notable exception of dissolved oxygen and ORP at a several wells (MW-03, MW-05, and MW-12) within the Quarry. The dissolved oxygen observed in wells MW-03, MW-05, and MW-12 are much lower than those observed in the other bedrock wells at the Quarry, less than 1 milligram per liter (mg/L) compared to typically greater than 5 mg/L in the other bedrock wells. These wells are situated either within the area of the landfarming (MW-05) and downgradient of the landfarming area (MW-12 and MW-03). The depressed dissolved oxygen may be related to the landfarming activities in the Quarry, rather than differences to the bedrock mineralogy. The natural attenuation of the contaminated soils landfarmed at the Quarry likely produced reducing conditions (i.e., low dissolved oxygen and ORP) that may have dissolved

several metals from the soil into the groundwater, most notably manganese and iron. The distributions of these metals, which were the highest at the site in these wells, correlate with groundwater flow from the landfarming area downgradient. Although well MW-7 also had similar groundwater geochemistry (low dissolved oxygen and ORP), the condition at MW-7 may be related to the confining conditions of the groundwater location rather than potential contamination, as no elevated metals concentrations were observed at well MW-7.

In summary, the screening the groundwater concentrations from the Quarry bedrock wells against those of the background bedrock wells is considered appropriate.

The Navy agrees not to compare sediment data with Coffins Pond for sediment background comparison, and so has been deleted from the SAP and also from Appendix D, Human Health Risk Assessment Methodology, and Appendix E, Ecological Risk Assessment Methodology.

Comment: Worksheet 11, "PQOs Listed in the Form of If/Then Qualitative and Quantitative Statements", page 50: The site-specific rather than statewide background values are applicable, and due to the filled material in the quarry the "mixed soil" values are appropriate.

Response: A thorough plan for evaluating background is already developed in the SAP. Earlier in Worksheet 11 (page 44), a discussion of applicable background values is provided and considers soil type variability, groundwater seasonal variations, and analytical suite. The Quarry site has a complex and varied geology and hydrogeology; therefore, comparison of site data to background data requires matching of the sample data as closely as possible with its appropriate background data category. Depending on the locations and conditions of soil encountered in the field, facility background Mixed Soil, Upper Sand, or Transition Unit classifications will be used. For groundwater, classification will be based on the well screen depths and previously established lithology from monitoring well installation; generally, data from monitoring wells located in the northeastern portion of the site will be compared to "Upper Sand Fall" background data, and monitoring wells located in the remainder of the site will be compared to "Bedrock Fall" background data.

Further details are provided specific to Appendix D – HHRA Methodology (Section 1.1.2) and Appendix E –ERA Methodology. Site data will be compared to background using lines-of-evidence such as site-specific facility background data for applicable metals and pesticides, or the MEDEP background PAH values, which are included in Maine's Remedial Action Guidelines (RAGs) Appendix 1 and 2 tables (MEDEP, 2013). For PAHs, available facility background values are not applicable, as further development is planned; the Quarry Area is undeveloped and expected to remain so, therefore, appropriate comparisons are to Maine's Rural Developed category for PAHs.

Several categories of facility background data are available. The facility background categories that will be used to match the varied site conditions, based on investigation results to date and to be refined following evaluation of the RI lithology data, where the munitions response site (MRS) is defined as the original Preliminary Assessment (PA) site boundary central to the site, are as follows:

For soil:

- "Mixed Soil" for surface and subsurface soil within the Quarry/MRS boundary
- "Mixed Soil" for surface soils between MRS and Old Route 24 and east of the MRS
- "Upper Sand" for subsurface soils between MRS and Old Route 24
- "Upper Sand" for surface and subsurface soils south of Old Route 24 and north of Radio Tower Access Road
- For subsurface soils east of the MRS, the background category will be dependent on what is encountered. It may be clay (Presumpscot) or sand. There is no UPL for the Presumpscot clay, so it is assumed that the default "Transition Unit" will be used. "Upper Sand" would be used if sand is encountered.

It is recognized that a few samples within each area could individually have a differing designation than the overall given area. If these samples differing in soil type from the overall area have concentrations that exceed both background and maximum concentration for the remainder of the area, the data will be further evaluated to determine whether the chemical concentration is greater than background for that area. Otherwise, these samples will be designated as part of the area as a whole and screened against background for that area.

For groundwater, background categories can be classified by area: the wells in the northeastern portion of the site would fall under "Upper Sand Fall/Spring", whereas the rest of the site would be "Bedrock Fall/Spring". To date, both sets of groundwater data were collected in the Fall. Specifically,

- "Upper Sand Spring" or "Upper Sand Fall" applies to wells MW-QRY-03, -09, -10, & -11
- "Bedrock Spring" or "Bedrock Fall" applies to all other wells (MW-QRY-01A/B, -02, 04, -05, -06, -07, -08, & -12).

For the HHRA, all wells are considered. For the ERA, where upwelling of groundwater to surface water could affect ecological receptors, groundwater data to be evaluated will be more focused to those wells (MW-QRY-02, MW-QRY-03, and MW-QRY-09) located near drainage areas at the site.

Also, as provided in Appendix D Section 1.5.1 Uncertainty in Data Evaluation, it is noted that in the uncertainty section of the HHRA, lines of evidence of background such as comparison with Maine background concentrations will be developed. The Quarry Area is undeveloped and expected to remain so, therefore, appropriate comparisons are to Rural Developed for PAHs. For metals, only Undeveloped ME UPLs are available for use.

7. <u>Comment</u>: Worksheet 14 Summary of Project Tasks – Soil Sampling: Depending upon the conditions at the time of sample collection, the screening necessary for MEC and radiological concerns may bias low any VOC of VPH data due to the exposure time to air and the mixing of soil. Groundwater data indicate neither group of compounds is a significant driver, but the field team should try to collect those samples as soon as possible after screening.

Response: The comment is noted, the following will be added to Worksheets 14 and 17: "The field team will collect VOC and VPH data as soon as possible after MEC and radiological screening." Safety of the field team is the priority.

- **8. Comment:** Worksheet 15a, Soil Reference limits:
 - Although not typically appropriate for screening values, please use the MEDEP remedial action guidelines (RAG) of 340 ppm for lead in soil;
 - The notes indicate that the PCB-Pesticide analysis that extracts will be evaporated to 2 ml to achieve detection limits. Please ensure that the associated quality control samples (blanks, laboratory control samples, and matrix spikes) are prepared by the same method as the samples. The lab should also be prepared to provide an MDL study to demonstrate the precision and accuracy of the modified method.

Response: The following responses address soil reference limits:

- The human health screening value for lead in Worksheet #15a has been revised to 340 ppm.
- The laboratory does concentrate the extraction quality control samples to the same 2 mL final volume as the samples. At this time, the laboratory does not have separate MDLs for a 2 mL final volume. The laboratory uses the 10 mL final volume MDL and adjusts it for the new final volume.
- 9. <u>Comment</u>: Worksheet 18, DUs Inside Quarry Fence and Figure 17-2: Please consider moving Trench 16 to the more significant anomaly approximately 30 feet to the southwest or explain the rationale (spatial distribution?) for locating Trench 12 and Trench 16 at smaller anomalies. For some locations there were hand-digs in that area to determine the source of the anomalies, but the larger one has not been investigated. This comment for information only, MEDEP will direct this to USA, who chose the trench locations.

Response: The trench has been re-located as requested, upon consultation with USA Environmental.

10. <u>Comment</u>: Figure 17-3B, Sample Collection and Path Forward Decision Tree: Please clarify the distinction between the "disturbed" and "undisturbed" soil fractions for collecting contingency and planned soil samples. It is not clear if it refers to the in-place soil being native or fill, or to the mixing of soil during excavation and screening.

Response: Within the SAP, including Figure 17-3B, "disturbed" refers to fill and "undisturbed" refers to native soil.

- 11. Comment: Appendix C Technical Memorandum Groundwater Report:
 - Nearby Residential Wells Current aerial photography for the Quarry site area shows that new houses are being built closer to the site than are shown by the Maine Geologic Survey information. By MEDEP's measure the closest house is approximately 1300 feet from the center of the quarry.
 - Conclusions and Recommendations MEDEP generally concurs with the recommendations of the report. Additional groundwater data and gauging are needed, based on rejected data for phenolic compounds in the 2012 round, and several exceedances of the Maine maximum exposure guidelines (MEGs). A second round prior to the risk assessment (HHRA) should be completed, or the additional data could be wrapped into a revised HHRA or Feasibility Study, and sampling may also be warranted following a remedial action (if one is needed) that involves excavation and sifting of the soil to determine whether there are impacts to groundwater quality. Data for the wells installed in 2012 indicate fluctuation of the inorganics can be significant, as some parameters were nearly four times higher in 2013 than in 2012. Since the last full round was completed in December, a follow-up would preferably be completed in the Spring, rather than late this year following soil/sediment/surface water collection. MEDEP would prefer to see a full round (with the exclusion of MW-QRY-11, and possibly MW-QRY-01B. Based on the data collected the analytical list can be reduced, dropping VOCs and PCBs. SVOCs/PAHs should be retained along with metals, explosives/perchlorate, and pesticides.

Response: Appendix C Technical Memorandum Groundwater Report and Worksheet #10 have been revised to state that, per recent aerial photography of the area, the closest house is located approximately 1300 feet from the center of the quarry site.

The Navy will collect an additional round of groundwater samples in the Spring of 2015 as requested. Further, per the comment, groundwater samples will be analyzed for SVOCs/PAHs, metals, explosives/perchlorate, and pesticides. Additionally, a round of groundwater levels will be collected during the Spring 2015 groundwater sampling event.

RESPONSE TO MEDEP FOLLOW-ON COMMENTS e-MAILED SEPTEMBER 24, 2014
CONCERNING NAVY COMMENT RESPONSE LETTER DATED SEPTEMBER 23, 2014
DRAFT SAMPLING AND ANALYSIS PLAN
SOIL/SEDIMENT/SURFACE WATER REMEDIAL INVESTIGATION OF QUARRY AREA,
DATED JULY 2014
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

<u>Follow-on Comment to #6:</u> #6 – paragraph 2 of the response I would like an explanation of the sentence that begins – "For PAHs, ..." It seems contradictory where it talks about development. I also disagree that the facility background values are "not applicable". The areas north, south and east of the quarry proper are the same sort of terrain we sampled in the study, the values need to be considered.

Response: The Navy agrees to future discussions/meetings on PAH background levels, to address MEDEP concerns, when validated PAH results are available. Methodology for HHRA, Appendix D, Section 1.1.2 Background Screen, and ERA, Appendix E, Section 3.0, has been revised to acknowledge that facility background values may or may not be applicable and use of background will be variable depending on the area of the site.

Also, the following text in the referenced sections of the HHRA and ERA has been deleted... "as further development is planned; the Quarry Area is undeveloped and expected to remain so".

Follow-on Comment to #8: #8 – If the lab has not demonstrated that it can hit the reporting limits using the method proposed then I do not see how Navy justifies its use. A mathematical calculation is not the same as demonstrating by the method used. They should run some low level spikes and prove they can do it.

Response: – The laboratory, Katahdin, has always done "concentrations (further concentration of a sample or sample extract)" in this manner, both for pesticides/PCBs and for metals. They understand that it is a mathematical calculation, but MDLs, LODs and LOQs are determined based on clean spiked water and so are not any more accurate to real world samples than using a mathematical calculation for a "concentration". There are some cases where Katahdin can't concentrate a sample to the standard final volume and have to leave it at a higher level, effectively introducing a dilution factor; Katahdin adjusts the MDL, LOD and LOQ accordingly. Katahdin views a concentration in the same way, only it lowers the adjusted MDL, LOD and LOQ. Katahdin has never done separate MDLs, LODs and LOQs for dilutions, and so doesn't do them for concentrations either. Katahdin doesn't believe that the DoD QSM has any information that specifically requires MDLs, LODs and LOQs for different initial volumes or final volumes used. Katahdin uses different volumes for many tests, depending on the sample matrix, and does not analyze volume specific reporting limits. As required, Katahdin reports limits adjusted for the volumes used.

<u>Follow-on Comment to #10</u> - #10 - The terminology is acceptable if it refers to the termination depth, but clearly the samples at locations such as 21, 27, 37, and 38 are not going to be native soils. No change needed if the sampling follows table 17-#.

Response: Table 17-1 will be followed.

RESPONSE TO MEDEP ADDITIONAL COMMENTS DATED SEPTEMBER 15, 2014 DRAFT SAMPLING AND ANALYSIS PLAN SOIL/SEDIMENT/SURFACE WATER REMEDIAL INVESTIGATION OF QUARRY AREA, DATED JULY 2014 APPENDIX D, HUMAN HEALTH RISK ASSESSMENT (HHRA) FORMER NAVAL AIR STATION BRUNSWICK BRUNSWICK, MAINE

Note that where the comment response provides revised text, text additions are shown in bold italics, and deleted text is shown as strikethrough.

General Comments

1. <u>Comment:</u> In general, DEP agrees with the approach presented in the HHRA Methodology. The few modifications requested are described in the specific text and table comments below.

Response: Comment noted. Please see responses to the specific text and table comments below.

Specific Comments

2. <u>Comment: Page D-8 COPC selection</u>. Because Site related chemicals may be present in some media below method detection limits, we suggest addition of a Step 3: "Step 3: Selected COPC will be compared across media, if a substance is identified as a COPC in one media, it will be carried forward for assessment in all exposure pathways."

Response: Risk assessment will be conducted in accordance with established protocols. COPC selection is conducted on a medium-specific basis. A sensitivity analysis is conducted during the data usability assessment where chemicals that are non-detected at levels greater than screening levels are identified. The potential effect of those exceedances is discussed qualitatively in the uncertainty analysis section of the HHRA for completeness. Chemicals with detection limits below risk-based screening levels will not be added to the quantitative evaluation. Chemical migration across media is accounted for and discussed in the Nature and Extent section of the RI Report.

3. <u>Comment: Page D-12 First bullet</u>. "The maximum concentration will also be used as the EPC in the event of an insufficient number of detections in a data set (i.e., less than four), in accordance with USEPA ProUCL guidance (2013)." This may be a miss-statement. The number of detections is not relevant to the ProUCL Guidance's recommendation of using the maximum if the sample size is less than 5, please confirm that non-detects will be included in the calculation of the UCL using Pro UCL.

<u>Response:</u> Non-detects will be included in the calculation of 95% UCLs in accordance with USEPA ProUCL guidance (USEPA, September 2013).).

The statements in the first bullet of Page D-12 have been revised to the following:

"For soil, groundwater, surface water, and sediment data sets containing at least five samples, the 95-percent upper confidence limit (UCL) on the arithmetic mean, which is

based on the distribution of the data set, will be selected as the EPC unless the UCL exceeds the maximum detected concentration. In this case, the maximum detected concentration will be used as the EPC. The maximum concentration will also be used as the EPC in the event of **or there are** an insufficient number of detections in a data set (i.e., less than four), in accordance with USEPA ProUCL guidance (2013)......"

4. <u>Comment:</u> <u>Page D-12 last paragraph</u>. To streamline effort by all parties involved with the risk assessment, MEDEP will accept presentation of the RME risks alone. If the RME presents risk, then the CTE can be estimated to assist risk management decisions.

Response: The CTE scenario will be included to assist in risk management decisions.

5. <u>Comment:</u> <u>Page D-13. ADAF adjustment factors.</u> The ADAFs are adjustments to the toxicity, not the intake. Although the net result will be the same, presenting ADAF adjustments in the intake equation is incorrect.

Response: Agree that ADAFs are applied to cancer slope factors in USEPA guidance (i.e., USEPA, March 2005), and that the net result is the same whether ADAFs are applied to intakes or to cancer slope factors. USEPA's methodology for calculating Regional Screening Levels (RSLs) applies ADAFs to calculated intakes (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/equations.htm).

The HHRA will apply ADAFs consistent with the methodology used to develop the RSLs.

6. <u>Comment:</u> <u>Page D-15 Toxicity Criteria.</u> Many of IRIS toxicity values are outdated. If an authoritative body in the toxicological hierarchy has a more recent value than that presented in the IRIS profile, it should be selected over the outdated IRIS value. Please consult the Maine RAGs for currently recommended toxicity values.

Response: Toxicity criteria used in the HHRA will follow the hierarchy specified in USEPA guidance (December 2003), as listed in Section 1.3.1 (Page D-15). Any considerable differences between the toxicity criteria used in the HHRA and the criteria recommended in the Maine RAGs will be discussed qualitatively in the uncertainty analysis section of the HHRA.

7. Comment: Page D-19 First sentence and 4th paragraph. "Current USEPA policy regarding lead exposures is to limit the childhood risk of exceeding a 10 microgram per deciliter (μg/dL) blood-lead level to 5 percent." and "The results of the IEUBK model and ALM model will be compared to the USEPA limit of 5 percent of children having a blood-lead concentration exceeding μg/dL. If a model output indicates that more than 5 percent of children are expected to have blood-lead concentrations exceeding 10 μg/dL, the risk is typically considered unacceptable."

These are miss-statements. As written it seems that EPA would allow 5% of exposed children to exceed the target risk level. The output of the IEUBK model is an estimate of the probability that any one exposed child will exceed the target blood lead concentration of 10 ug/dl. In other words, if the model output indicates that there is greater than a 5 % probability that any one child will exceed 10 ug/dl, the risk is considered unacceptable.

Response: Revisions have been made to statements discussing the USEPA benchmark for lead as follows:

Page D-14, 3^{rd} paragraph, second to last sentence: "This probability is typically compared to the USEPA goal of limiting the childhood-risk of **a child** exceeding a 10 μ g/dL blood-lead concentration to 5 percent."

Page D-19, 1st paragraph, last sentence: Current USEPA policy regarding lead exposures is to limit the childhood-risk of **a child** exceeding a 10 microgram per deciliter (μg/dL) bloodlead level to 5 percent.

Page D-19, 4th paragraph, 2nd and 3rd sentences: "The results of the IEUBK model and ALM model will be compared to the USEPA limit of 5 percent of children having a blood-lead concentration exceeding 10 μ g/dL goal of limiting the risk of a child exceeding a 10 μ g/dL blood-lead concentration to 5 percent. If a model output indicates that 5 percent of children are expected to have blood-lead concentrations exceeding 10 μ g/dL more than a 5 percent risk of a child exceeding a 10 μ g/dL blood-lead concentration, the risk is typically considered unacceptable."

General Risk Table Comments:

8. <u>Comment:</u> Surface areas and body weights not specifically given in EPA's 2014 OSWER directive should be calculated for the site specific receptors using the values 2011 Exposure Factors Handbook. The default exposure parameters presented in the Maine RAGs Guidance (MEDEP 2011)¹ should be used wherever appropriate. This review attempted to point out discrepancies, but may have missed some. Specifically, the exposure parameters used in CTE tables were not carefully reviewed at this point in the risk assessment because initial decisions will be made using the RME.

Response: In general, default values from Maine RAGs Guidance (MEDEP, 2011) will be used for the receptors when available and appropriate if values are not provided in USEPA's 2014 OSWER directive. Values in the USEPA 2011 Exposure Factors Handbook will be considered for remaining exposure assumptions for receptors not included in the 2014 OSWER or 2011 MEDEP guidance. Site-specific conditions are also considered in determining exposure assumptions.

Specific Comments on the Risk Tables:

9. <u>Comment:</u> <u>Table 4.1</u>. The averaging time for a construction worker is 0.5 years, although it seems odd that it is a 250 day/year exposure frequency, using the 6 month exposure duration results in a 125 day exposure.

Response: Table 1 Standard Default Exposure Assumptions for Maine Risk Assessments within the Maine Risk Assessment Manual (http://www.maine.gov/dep/spills/publications/guidance/) lists a 250 day/year exposure frequency for the Construction Worker exposed to soil. The exposure duration of 1 year is based on the USEPA reference included in Table 4.1. The reason the USEPA exposure duration was chosen instead of the MEDEP exposure

http://www.maine.gov/dep/spills/publications/guidance/rags/final_5-8-2013/1%20Risk%20Manual-Feb_2011-%20CC.pdf

duration is because the MEDEP exposure duration for the Construction Worker is not logical when considering the corresponding exposure frequency (i.e., How can 250 day/year be included in 0.5 years or approximately 183 days?).

10. <u>Comment:</u> <u>Table 4.3, 4.5</u>. The Maine construction worker exposure frequency to groundwater (or surface water) is 26 days per year, the averaging time and exposure duration are both 0.5 years.

Response: The exposure frequency for the construction worker exposed to groundwater and surface water will be changed from 30 days per year to 26 days per year, and the averaging time and exposure duration will be changed from 1 year to 0.5 year.

11. <u>Comment:</u> <u>Table 4.6</u>. MEDEP does not agree with use of a fraction ingested (FI) of 0.5 for sediment exposure. The decreased exposure for sediment contact has already been accounted for with the decreased exposure time and exposure frequency. Please use 1 for a FI or present the rationale for an alternative value.

<u>Response:</u> The FI of 0.5 is used for construction worker exposure for sediment to indicate that the receptor is only exposed to sediment for part of the day. This is expected to be appropriate for sediment because it is unlikely that construction workers would be exposed to sediment for an entire day.

12. <u>Comment:</u> <u>Table 4.7</u>. The CTE Exposure frequency is stated to be 50% of RME, therefore value should be 125 days/year.

<u>Response:</u> Agree, the CTE exposure frequency for industrial workers exposed to soil in Tables 4.7 and 4.8 has been changed to 125 days/year.

13. <u>Comment:</u> <u>Table 4.8</u>. The reference to USEPA, 2014b: "Site-specific values for Hartford, Connecticut" should be corrected to state that these are the values for Portland Maine. The CTE exposure frequency is stated to be 50% of RME, therefore value should be 125 days/year.

Response: Agree, the reference has been revised to indicate the site-specific values are for Portland, Maine. The exposure duration on Table 4.8 CTE has been changed to 125 days/year.

14. <u>Comment:</u> Table 4.9. Is a six year old trespasser an appropriate receptor for this site? A teen/young adult may be more appropriate. The trespasser in Maine is exposed to soil 52 days per year (2 days/week, 26 weeks per year). The trespasser body weight and exposed surface areas should be recalculated using the surface areas presented in the 2011 Exposure Factors Handbook (for the appropriate age interval currently 6 to <16). The Maine default exposure time for surface water is 2.6 hours per event (EPA 1989 RAGs Part A, exhibit 6.3).</p>

Response: No change is necessary for the trespasser exposure duration. According to the 2014 OSWER directive, adult resident exposure durations are 20 years and child resident exposure durations are 6 years. Therefore, resident exposures are for ages 6 through 26. Based on this, exposure durations for an adolescent trespasser (6-16 years of age) and adult trespasser (16 to 26 years of age) will be applied to recreational users for the HHRA to

be conservative. It is likely that exposures for an older child/young adult receptor (e.g., ages 16 to 26) would be more appropriate for the site; uncertainty associated with receptors evaluated will be discussed in the uncertainty analysis of the HHRA.

15. <u>Comment:</u> <u>Table 4.13.</u> Note (3) about the mutagenic mode of action does not seem to correspond to the exposure duration for the adult trespasser.

Response: No changes are warranted. Agree that no adjustment is made for chemicals acting via a mutagenic mode of action for receptors greater than 16 years of age, as indicated by the use of an ADAF of 1 (please see Section 1.2.4). Therefore, footnote (3) will remain on Table 4.13 for consistency and to indicate that mutagenic effects were considered for the adult trespasser.

16. <u>Comment:</u> <u>Tables 4.23 and 4.24.</u> These tables are labelled Adult Recreational Use, but present ages 6-26. Perhaps older child/young adult would be more appropriate.

Response: Please see the response to Comment 14. No change is necessary for the recreational user exposure duration. The residential exposure durations (i.e., adults from ages 6 to 26) will be applied to recreational users for the HHRA, to be conservative. It is likely that exposures for an older child/young adult receptor (e.g., ages 16 to 26) would be more appropriate for the site; uncertainty associated with receptors evaluated will be discussed in the uncertainty analysis of the HHRA.

17. <u>Comment:</u> <u>Table 4.28</u> The default volatilization factor of 0.5 L/m3 does not appear to be cited in the EPA RAGs Part A 1989 document, but is in RAGs Part B EPA 1991.

Response: Agree, the reference has been updated.

18. Comment: Tables 4-15 4-29, 4-30 and 4-35, 4-36. Residential surface water and sediment exposures. Maine has a default wading exposure scenario of 2.6 hours per event², 78 days per year (3 days per week, 26 weeks per year). The total exposure duration should be 26 years. If there are reasons to deviate from the defaults, please define them.

Response: No change is needed for the exposure duration, as the total exposure duration (child plus adult) is currently 6 years for the RME scenario. The proposed changes have been made for exposure frequency and exposure time for surface water and sediment.

² EPA USEPA 1989 Risk Assessment Guidance for Superfund Vol 1. Human Health Risk Evaluation Manual Part A.

Klink, Linda

From: Daly, Michael < Daly.Mike@epa.gov>
Sent: Friday, June 27, 2014 2:54 PM

To: Klink, Linda; 'Bober, Todd A CIV NAVFAC MIDLANT, PWD Pennsylvania'

(todd.bober@navy.mil); 'Burgio, Paul F CIV NAVFACHQ, BRAC PMO'

(paul.burgio@navy.mil)

Cc: McLeod, Iver J (Iver.J.McLeod@maine.gov); 'Evans, Chris' (Gordon.C.Evans@maine.gov);

Barclift, David J CIV NAVFAC LANT, EV (david.barclift@navy.mil); Leclerc, Robert CIV

NAVFAC HQ, BRAC PMO (robert.leclerc@navy.mil); DeJesus, Caryn

(caryn.dejesus@aecom.com); Robert Hierholzer (rhierholzer@usatampa.com); Coffman,

Michelle; Orient, Jeff

Subject: NA Brunswick: Revised Quarry UFP SAP Strategy for Soils & Sediments

Good afternoon Linda, Todd, & Paul – I've completed a review of the revised soil/sediment sampling decision logic and accompanying tables, figures & worksheets associated with the Quarry RI SAP. These tables and figures were provided to the regulators via e-mail on 5/21 & 6/25. In summary, I see no significant issues that would require any substantive changes to the technical approach & associated details of the field sampling plan (FSP). Barring any surprises encountered during implementation of the fieldwork that would require FSP modification(s), the end product of this field investigation should be a very robust data set to allow assessment of potential site soil/sediment risk and development of remedial alternatives to address any potential unacceptable site risk.

If you have any questions, please let me know.

Thanks,

Mike

From: Klink, Linda [mailto:Linda.Klink@tetratech.com]

Sent: Wednesday, June 25, 2014 5:20 PM

To: Daly, Michael; McLeod, Iver J (Iver.J.McLeod@maine.gov); 'Evans, Chris' (Gordon.C.Evans@maine.gov); 'Bober, Todd A CIV NAVFAC MIDLANT, PWD Pennsylvania' (todd.bober@navy.mil); 'Burgio, Paul F CIV NAVFACHQ, BRAC PMO' (paul.burgio@navy.mil); Barclift, David J CIV NAVFAC LANT, EV (david.barclift@navy.mil); Leclerc, Robert CIV NAVFAC HQ, BRAC PMO (robert.leclerc@navy.mil); DeJesus, Caryn (caryn.dejesus@aecom.com); Robert Hierholzer (rhierholzer@usatampa.com); Coffman, Michelle; Orient, Jeff

Subject: Brunswick Picnic Pond and Quarry discussion

Hi, all

I had an action item to provide you all with Worksheet #18 of the SAP for the Quarry Soil/Sediment RI, which details the sampling strategy sample by sample.

Please see the attached.

Linda Klink, P.E.,PMP | Senior Project Manager
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RESPONSE TO BACSE COMMENTS DATED SEPTEMBER 4, 2014
DRAFT SAMPLING AND ANALYSIS PLAN
SOIL/SEDIMENT/SURFACE WATER REMEDIAL INVESTIGATION OF QUARRY
AREA, DATED JULY 2014
FORMER NAVAL AIR STATION BRUNSWICK
BRUNSWICK, MAINE

Note that where the comment response provides revised text, text additions are shown in bold italics, and deleted text is shown as strikethrough.

General Comments

1. <u>Comment</u>: Decision Units: As stated in Worksheet #10 of the SAP boundaries of the Quarry site have expanded from 4 acres to 80 acres and the final boundaries have yet to be defined.

Initial boundaries of the Quarry Area were provided by former NAS Brunswick Environmental Office personnel for the 2007 PA Report. The Quarry Area originally comprised approximately 4 acres based on the 2007 PA Report. This area is referred to as the Quarry MRS. The area of investigation has been expanding during previous activities, and the proposed investigation boundary for the Quarry Area is now approximately 80 acres, and includes areas north, south and east of the original site boundary and area west of the site and west of SR123. It is expected that the Quarry MRS boundary will be redefined within the area shown on Appendix A of this SAP, Figure 2, after evaluating results of the proposed coordinated RI.

The SAP acknowledges that the Quarry site history and geology is complex. Despite this complexity and the fact the site boundaries are still unknown, the site has been divided into 6 Decision Units (DU) as described on Page 4 of the SAP.

To facilitate an effective evaluation of chemical contamination and because of the mixed history of Quarry Area, the site was divided into the following decision units (DUs) based on site operations and various media of interest, included in parentheses

- DU1 Quarried Backfill Area North of Radar Tower Access Road
- DU2 Quarried Backfill Area Inside Quarry Fence
- DU3 Landfarming Area
- DU4a Detonation Area (soil)
- DU4b Kickout Area (soil)
- DU5 Seasonal Drainage Areas
- DU 6 Groundwater (monitoring wells were installed and groundwater samples collected in 2012 and 2013).

The areas inside the Quarry fence (DU2, DU3, and DU4a) are of most concern from a chemical contamination perspective because that is where waste disposal occurred. Lateral and vertical boundaries for DU1 through DU5 are not yet established. Although some DUs overlap laterally, these overlapping DUs can be differentiated vertically based on the current-day CSM. Specifically, DU3,

Landfarming Area, and DU4b, Kickout Area, are vertically situated above DU2, Quarried Backfill Area Inside Quarry Fence.

SAP Worksheet#11 states that:

A Decision Unit (DU) is defined as the smallest area about which a risk-based decision can be made. Based on the CSM, the Quarry Area has been divided into six primary DUs (DU1 through DU6) selected to account for anticipated differing contaminant sources (MC or non-munitions- related waste) and concentrations (see Figure 11-1 and Table 17-1).

No basis has been provided for the delineation of these DUs in the SAP, nor are the boundaries of the DUs clearly shown. Nevertheless these DU designations are used as a basis for defining sampling programs and may be used to establish exposure units for risk assessment. Given the limited information available on site conditions and the uncertain boundaries of impacted areas around the quarry, BACSE believes that it is premature to delineate decision units (DU) at this time.

Response: The boundary of the Quarry MRS is approximately 4 acres considering the disposal area only, the investigation area for the Quarry Site has expanded to approximately 80 acres considering kickouts of munitions items from historical detonation operations. The Quarry site boundary and DU boundaries will be refined and established once the field work is complete and the results have been evaluated; the re-definition is expected to result in a boundary encompassing much less area than investigated. Decision units (DUs) were established based on known or presumed site operations to account for anticipated differing contaminant sources and various media of interest (e.g., DU3 is the landfarming area and DU6 is groundwater). However, as stated in the SAP, lateral and vertical boundaries for DU1 through DU5 are not yet established. DUs are straightforward in terms of establishment by media, soil (DU1, DU2, DU3, DU4a/b), surface water/sediment (DU5), and groundwater (DU6). For any of the media, further subdivisions of DUs may occur upon completion of the investigation, for example, one of the ponds may be highly contaminated and so DU5 would then be further defined as DU5a, DU5b, and DU5c. Conversely, DUs may be combined if contamination is similar, for example, if the DU1 backfilled area north of the road is found to contain construction debris and munitions items, it would be combined with the DU2 backfilled area within the fence. In summary, the Conceptual Site Model (CSM) is refined each time new data is obtained.

2. Comment: Record of Decision: As described in the 2011 Action Memorandum for the Quarry Area prepared by Tetra Tech NUS for the U.S. Navy the Quarry is known to contain Munition of Explosive Concern (MEC), consisting of discarded military munitions (DMM) and UXO, potentially presenting an explosive hazard. MEC represents a safety hazard and may constitute an imminent and substantial danger to on-site personnel, local populations, and the environment due to its explosive potential. The Exploratory Investigation Report provided visual evidence that MEC is present at the Quarry Area and likely extends beyond the previously established site boundaries. In addition to explosive ordinance, the nature and extent of the chemical contamination in various media at the site has not been fully characterized at this point. Given the confirmed presence of munition wastes, the expanding footprint of

the site and its close proximity to residential neighborhoods, BACSE believes that it is the best interest of the community that a Record of Decision (ROD) be developed for this site. BACSE requests the U.S. Navy develop a timeline for the establishment of a ROD for the Quarry site.

Response: Because both chemical contamination and munitions items have been identified at the Quarry to date, this site will proceed through the CERCLA process, which ultimately includes the preparation of a ROD. It is anticipated that a ROD for the Quarry Site will be prepared in 2016/2017.

Specific Comments

3. Comment: Executive Summary (Page 3)

The SAP notes that the report associated with the **Quarry Area Groundwater Work Plan Tech Addendum** is in draft form and under review. To date, BASCE has not been provided with a draft copy of this report for review. BASCE recommends that the review of the Quarry groundwater report be completed prior to undertaking this SAP in the event the comments or report findings have a bearing on the design and implementation of this sampling and analysis plan.

The SAP states that the primary objective of the Quarry RI SAP is

To provide sufficient data to identify any areas that are contaminated with MC and/or non-munitions-related contaminants. Pending the results of the MEC investigation, those areas that are identified as non-contaminated with respect to MEC, MC, or other wastes may be removed from the Quarry Area site boundary and potentially available for transfer. A second sampling objective is to calculate ecological and human health risk to aid in decision making.

BACSE cautions against identifying sub-portions of the Quarry site for transfer prior to:

- Completing an accurate definition of the site boundaries.
- Acquiring a thorough understanding of the nature and extent of contamination in all media.
- Completion of a comprehensive site-wide risk assessment. (Also see comment #2 about ROD

<u>Response:</u> The Technical Memorandum Groundwater Report for the Quarry Area (report associated with the Quarry Area Groundwater Work Plan Tech Addendum) is provided in Appendix C of the SAP. The phrase "and potentially available for transfer" has been deleted from the above referenced sentence in the Executive Summary and also from Worksheet #11.

4. Comment: SAP Worksheet #10- Site History and Background (page 37)

<u>Geology:</u> Please correct the text to read: which included extensive *quarrying* of the bedrock, rather than *mining*.

<u>Hydrogeology</u>: The current interpretation of the groundwater flow directions is based on a limited characterization of the bedrock aquifer. In interpreting groundwater flow directions in fractured bedrock, comparison of relative head conditions is often insufficient, particularly across varying lithologic types. Detailed information fracture interconnectiveness by measuring hydraulic responses to ambient and pumping conditions may be needed for an accurate interpretation flow direction and contaminant migration. Furthermore, no information is provided on vertical gradients in the bedrock which could strongly influence the rate and direction of contaminant migration.

Response: The Geology section of Worksheet #10 has been revised, "These findings are consistent with the history of the site, which included extensive mining quarrying of the bedrock..."

Concerning the Hydrogeology information, the bedrock characterization performed to date is sufficient, and the interpretation of groundwater is technically sound. The bedrock wells installed to date provide sufficient spatial coverage of the potential groundwater migration paths from the Quarry area. The bedrock monitoring wells are screened in the upper, fractured bedrock, which is the zone where contamination is most likely to be found, and wells were placed in the most likely areas where contaminant releases to groundwater may have occurred. The concentrations of the two constituents greater than screening criteria in bedrock were limited to RDX, an explosive, and manganese, a metal. The concentration of RDX was slightly greater than screening criteria and does not suggest significant contamination. Of the bedrock wells, manganese was only detected in the two wells within the Quarry area (MW-05 and MW-12). Manganese was also detected in the overburden well downgradient of the quarry (MW-03) at a similar concentration, suggesting possible changes in the geochemistry (possible due to land farming activities) that affected the shallow groundwater. Given these factors, characterization of the deeper bedrock is not considered warranted.

The shallow bedrock at the Quarry area is fractured, and typically had Rock Quality Designations (RQDs) of less than 50%, indicating relatively high fracturing. The RQD increased with depth, but the screens of the bedrock wells were within the highly broken/fractured zones that would be most likely to be impacted by releases from the quarry fill materials. Although there are lithologic differences across the site, these differences do not appear to influence the hydrogeology at the site. The orientations of foliation and jointing features, measured during the bedrock fracture trace analysis study (Tetra Tech, 2012), cluster relatively tightly across the site and are consistent between lithologies. Furthermore, the bulk hydraulic conductivities in the shallow bedrock were greater than those estimated for the unconsolidated material, suggesting significant fracturing and interconnectedness of the shallow bedrock. Therefore, the interpretation of groundwater flow based on head elevations is technically sound. The head elevations observed in the shallow bedrock correspond to the head elevations in the unconsolidated materials, further indicating that the shallow bedrock is well interconnected as well as hydraulically connected to the unconsolidated zone.

5. Comment: SAP Worksheet #11- Project quality Objectives (page 40)

As stated in comment #1 BASCE believes that there is insufficient data to define Decision Units.

<u>Sampling Techniques:</u> The SAP states that Direct Push Techniques (DPT) drilling will be used if mechanical excavation is unsuccessful. Difficulties were encountered with DPT on Site 9 (see BASCE letter dated October 26, 2012) which resulted in inadequate characterization. Please provide an explanation of in the event DPT are used, how this problem will not be repeated.

Response: Refer to response to Comment #1 concerning the Decision Units. The geology of the study area can be reasonably estimated based on information available currently. The depth to the quarry floor can be confidently estimated, as can the area of disturbed or reworked surface material, which is relatively small. DPT may be used at proposed mechanical excavation locations, as a contingency in the event that using an excavator is unsuccessful (e.g., water fills in the excavation hole and the excavator cannot continue). DPT will also be used to provide continuous lithologic profile information at select locations and will be advanced to bedrock or to undisturbed native materials; thus, the DPT borings will extend beyond the point where wastes/concerns may be present. DPT has been (and continues to be used) quite effectively for investigations throughout the former NAS Brunswick. Therefore, the Navy is confident that the DPT will similarly provide good information for the pending Quarry soils investigation as well.

6. Comment: SAP Worksheet #14- Summary of Project Tasks (page 56)

Subsurface and Discrete Sampling: The SAP states that:

Discrete surface soil samples will be collected from 0 to 1 foot bgs, and discrete subsurface soil samples will be collected from 2-foot intervals at the depths specified in Table 17-1. All samples will be analyzed for MC constituents consisting of explosives including NG, and TAL metals. As warranted, samples will additionally be analyzed for VOCs, SVOCs, EPH/VPH, pesticides, and PCBs.

What criteria will be used to identify which samples will be analyzed for the additional analytes VOCs, SVOCs, EPH/VPH, pesticides, and PCBs?

Sediment and Surface Water sampling – DU5

The SAP notes that surface water sample sites only have shallow standing water intermittently. What is the expected timing for collection of surface water samples from the three sample sites: 1) area along the base of the quarry rock face, 2) the western surface drainage near Route 123 and 3) the Vernal Pool#42? What is the plan if these areas are dry at the time of the investigation?

Response: As presented in Worksheet #18 and on Table 17-1, samples collected in DU1 (if collected), DU2, DU3, and DU4a will be analyzed for explosives, NG, and TAL metals as well as VOCs, SVOCs, EPH/VPH, pesticides, and PCBs due to the varied history and unknown disposal practices within this area.

Because surface water in these areas is intermittent, it is expected that concentrations of analytes in sediment will be more indicative of potential contamination to these areas because contaminants, if any, are expected to adsorb to fine-grained sediments. Surface water samples will be collected prior to the MEC investigation as these areas will be drained prior to this investigation, further, surface water samples will only be collected if surface water is present in the seasonal drainage areas during sampling.

Note that perchlorate and hexavalent chromium analyses (select samples) have been added to the analytical suite for surface water, as per the response to BACSE Comment 7 below.

7. <u>Comment</u>: SAP Worksheet #15a, b, c- Reference Limits, Soil, Sediment and Surface Water

Perchlorate was detected in the groundwater during the 2012 and 2013 sampling events in the quarry. It does not appear on the worksheet. Perchlorate should be included as an analytical parameter in the soil, sediment and surface water sampling programs.

Perfluoridated compounds (PFCs) do not appear on the worksheet. Similarly, BACSE recommends that PFCs be included in the RI sampling program at the Quarry?

In the analysis of Chromium, both Chromium +3 and Chromium +6 should be analyzed and reported.

Response: Please see the following chemical specific responses:

<u>Perchlorate</u>: Perchlorate does not appreciably sorb to soils and its mobility and fate are largely influenced by hydrologic and biologic factors; therefore, perchlorate would not be expected to be present in soil and sediment. Furthermore, perchlorate in groundwater was less than screening criteria. Perchlorate has been added to the surface water sample analyte list.

<u>PFCs:</u> The Navy is currently preparing a base-wide study on the presence/absence of PFCs. Based on historical information and interviews, PFCs are not suspected at the Quarry site and so no PFCs sampling is included.

<u>Chromium:</u> Total chromium is already included in the analyte list. Hexavalent chromium has been added to a 10 percent subset of the samples for all media, which includes soil, sediment, and surface water. Note that for the 2010 opportunity soil sampling at the Quarry, only one of the total chromium results nominally exceeded facility background (59.8 mg/kg vs. 54.7 mg/kg); the 2012/2013 groundwater RI results for total chromium were all nondetect (4 ug/L).

8. Comment: SAP Worksheet #16 - Project Schedule

Worksheet 16 refers to Figure 16-1 Gantt Chart. No Figure 16-1 was found in the Quarry RI SAP. Please provide a copy of Figure 16-1 and include the anticipated start and end dates in Worksheet #16.

Response: The recently updated Gantt Chart, developed by USA Environmental, has been added to the Quarry MC SAP as Figure 16-1. The start and end date table has been deleted.

9. Comment: SAP Worksheet #17 – Sampling and Decision Rationale (Page 90)

DU 1 Quarried Backfill North of Radar Tower

The SAP states

Although not supported by MEC investigation results to date, surface and subsurface soil within DU1 may be contaminated based on the quarrying and backfilling activities that extended into this area, and it is also possible that munitions items are present in backfill materials. Landfarming did not take place in this area nor have drums been identified in this area to date. The media of interest for DU1 are surface soil (0 to 1 foot bgs) and subsurface soil (greater than 1 foot bgs). However, soil contamination is only of concern if waste materials or munitions items are identified within the backfill used in this area..... If and only if evidence of waste/munitions disposal is found within the backfill, full-suite analyses will be conducted (explosives including NG, TAL metals, VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, VPH).

BACSE disagrees that surface and subsurface soil contamination is only a concern if waste materials or munitions are identified. It is not possible, based on visual observation, to confirm that the soil is not contaminated. Therefore BACSE recommends that all samples of fill material encountered in this area be analyzed for the complete suite of analytes including explosives, TAL metals, VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, VPH.

DU 2, Quarried Backfill Area inside Quarry Fence

Based on the same principals BACSE recommends that all samples of fill material encountered in this area be analyzed for the complete suite of analytes including explosives, TAL metals, VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, VPH.

DU 4b, Kickout Area

The text notes that two drums were previously identified east of the rock wall, but the proposed sampling only includes MC-related compounds. Unless the Navy can confirm unequivocally that there are no other drums, spills or other waste materials in DU 4b, BACSE recommends that all samples of fill material encountered in this area be analyzed for the complete suite of analytes including explosives, TAL metals, VOCs, SVOCs [including low-level PAHs], PCBs, pesticides, EPH, VPH.

Response: If no fill, construction materials, trash, or munitions items are present, there is no need to suspect soil contamination. Additional sampling will be considered by the Navy in the future if warranted upon evaluation of results. Based on results to date, indicating low contaminant concentrations in both the groundwater and soil (during the 2010 soil sampling effort), the proposed sampling program is adequate.

10. Comment: SAP Worksheet #18 – Sampling Locations and Methods (Page 104)

Based on this worksheet it appears that only 1 sample per surface water body is planned. BACSE recommends that a minimum of two samples, separated either spatially or temporally, be obtained at each sample location to characterize the surface water quality since it is an important element of the risk assessment.

Response: Surface water in these small water body areas is intermittent, it is expected that concentrations of analytes in sediment will be more indicative of potential contamination to these areas because contaminants, if any, are expected to adsorb to fine-grained sediments. Therefore, one surface water sample, per area, is included for collection (surface water samples will only be collected if surface water is present in the seasonal drainage areas during sampling). Additional sampling will be considered by the Navy in the future if warranted upon evaluation of results. Moreover, groundwater data will be conservatively evaluated in the Ecological Risk Assessment (ERA), assuming a pathway exists for groundwater discharge into the surface water bodies.